Vol. XVI No. 6

DISSERTATION ABSTRACTS

ABSTRACTS OF DISSERTATIONS AND MONOGRAPHS IN MICROFORM

UNIVERSITY MICROFILMS
ANN ARBOR, MICHIGAN: 1956

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INTRODUCTION

This year for the first time *Dissertation Abstracts* will carry, as the 13th issue of Volume XVI, an index to all doctoral dissertations published in the United States and Canada. This issue will be titled *Index to American Doctoral Dissertations*, and will be a continuation of *Doctoral Dissertations Accepted by American Universities.*[1] The joining of these two reference works makes it possible for librarians to have an integrated bibliographical research tool relating to doctoral dissertations under one cover.

Dissertation Abstracts will continue to provide abstracts of dissertations by recipients of doctoral degrees from graduate schools cooperating with University Microfilms in the publication of complete dissertation texts on microfilm, on Microcards, or as microprint. At the end of each abstract will be found an indication of the number of pages in the original typescript and the Library of Congress card number, for the convenience of scholars and research workers. In some instances *Dissertation Abstracts* will be found to be an adequate substitute for the published dissertations.

The *Index to American Doctoral Dissertations* will be a complete indexed listing of dissertations by students who were granted doctoral degrees during the previous academic year, and including those abstracted in *Dissertation Abstracts*, arranged by degree-granting institutions under appropriate subject headings. An alphabetical author index will be included.

The tabular material which has been an established part of its predecessor volume will be included in full, so arranged that statistical summaries can be maintained with no break in continuity.

It is hoped that those who use *Dissertation Abstracts* will continue to make suggestions for its improvement, as these are vital to its continued life and growth. Several suggestions for changes in the headings used for indexing purposes have been received, and a committee of the Association of Research Libraries is reviewing the indexing system at the present time as a result of these suggestions.

[1] Arnold H. Trotier and Marian Harman, (eds.), *Doctoral Dissertations Accepted by American Universities.* (New York: H. W. Wilson Co., 1933-1955.)

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AGRICULTURE, GENERAL

EFFICACY OF THE ENVIRONMENTAL INDEX[6]

(Publication No. 14,757)

Robert Haynes Benson, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Edwin E. Heizer

Two groups of fourteen registered Holstein-Friesian females were balanced according to age, month of next freshening, lactation number, and previous production. The three first calf heifers in each group were balanced according to their sires and the production of their dams. These herds were used to test the efficacy of the Environmental Index[6].

Controlled differences between the two herds were limited to length of dry period, condition at freshening, days carried calf during the 305 day lactation, pounds of TDN fed daily per 1000 pounds of body weight during the winter feeding period, and the nutritive ratio of the ration. The sixth factor in the Environmental Index[6], size of herd, was kept constant. One group (designated high group) was placed on a high environmental plane of feeding and management while the other (designated normal group) received a normal level which approximated that routinely given to the University herd. Heart girth measurements and scale weights were taken bi-weekly throughout the lactation period. The first weight was taken on each cow from one to fourteen days after freshening since all cows were weighed and measured on the same day.

The average difference in production between these two herds as predicted by the Environmental Index[6] was 52 pounds of M.E. butterfat. The high and normal herds averaged 496 and 463 pounds, respectively, which was an actual difference of 33 pounds. The index prediction was 19 pounds too high; however, the three heifers in the high group averaged 54 pounds of butterfat less than the heifers in the normal group. When the index prediction on the 11 cows in each group was compared with the actual production of these cows, the predicted difference of 58 pounds compared quite closely with the actual difference of 56 pounds of butterfat. The three heifers in each group either differed greatly in their inherent ability to produce or the higher feeding level was detrimental to the heifers in the high group.

The within cow correlations between scale weights and heart girth measurements were .68 and .70 for the high and normal groups, respectively. The 308 tape weights on the cows in the high group averaged 1.5 pounds above the scale weights. Two-thirds of the tape measurements were within 52 pounds of the scale weights. The tape weights of the cows in the normal group averaged eight pounds above the scale weights with a standard deviation of 42 pounds. In the analysis of the tape and scale weights, significant differences were found between cows and between periods for each herd. The interactions between cows and periods, between cows and methods of weighing, and between periods and methods were also significant for each herd. The interaction between periods and groups was significant for the scale weights but not for the tape measurements.

The data were analyzed to ascertain if a combination of roughage weights and tape measurements would be applicable to field use for allocating the hay and silage to individual cows on a 1000 pound body weight basis. It was concluded that the total feed weights for the winter feeding period should be used in conjunction with tape measurements taken at two or more weigh days.

72 pages. $1.00. Mic 56-1618

GAMMA RAY SOIL DENSITOMETRY AND ITS USE IN EVALUATION OF SOIL PHYSICAL CONDITION

(Publication No. 16,693)

James Arthur Vomocil, Ph.D.
Rutgers University, 1956

A device for measuring the bulk density of soil in situ was constructed and tested for use as a tool in evaluation of soil physical condition. It was a modification of an instrument used by engineers for measurement of density of soil for roadbeds, landing strip subgrades, and foundation footing.

The instrument measures the relative transmittancy of the soil for the gamma radiation of the radioisotope cobalt 60. This transmittancy decreases as the wet bulk density of the medium increases. The method employing the apparatus was found to be rapid, simple to use, adequately precise, and usable to depths of about 30 inches with a minimum of plot disturbance.

The technique employing the densitometer was found to provide another characteristic for the evaluation of soil management practices such as crop rotations, cover cropping, reduced tillage intensity, and subsoiling. The average profile density to depths of 16 or 18 inches was found to be closely related to crop yields if the densities encountered were sufficiently high. Over the range of densities studied on the Nixon and Sassafras loams, which included the most commonly occuring conditions, the relationship between average bulk density and yield of sweet corn, field corn, and potatoes was found to be approximately parabolic with yields dropping abruptly at profile average bulk densities of 1.55 or higher. There was a separate curve for each crop indicating crop differences in sensitivity to aeration; sweet corn being more sensitive than potatoes, these in turn more sensitive than field corn.

It was pointed out that both "limiting" and optimum densities of the soil would vary with texture, soil depth, soil drainage, crop and season. Due to the variations in yield-density relationship with presently uncontrollable factors, it was suggested that soil air space at field

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capacity, calculable from bulk density and field capacity estimates, might provide a more generally useful index of soil physical condition. 107 pages. $1.34. Mic 56-1619

AGRICULTURE, ANIMAL CULTURE

NEUROANATOMICAL STUDIES RELATED TO THE PRODUCTION OF PARAVERTEBRAL ANESTHESIA OF THE LATERAL ABDOMINAL WALL IN THE BOVINE

(Publication No. 16,547)

John Phillip Arnold, Ph.D.
University of Minnesota, 1956

The advantages of segmental anesthesia in surgery involving the lateral abdominal wall of cattle and the inconsistent results associated with the paravertebral technique of Farquharson makes clear the need for fundamental research on the problem.

The studies which were carried out in the attempt to explain the failures of the Farquharson technique and improve or suggest a new technique were divided into four parts, namely: 1. Gross anatomical dissections, 2. Experimental transections of various spinal nerves and their components, 3. Effect of various concentrations of anesthetic solutions on nerves and the tissues surrounding them, and 4. Clinical trials.

The dissections showed that the most common surgical area of the lateral abdominal wall is innervated by the thirteenth thoracic and the first two lumbar spinal nerves. If the surgery involves the posterior part of the abdominal wall, the third lumbar spinal nerve is also involved. The spinal nerves in question follow a variable course in respect to the transverse processes of their respective vertebra. The dorsal branch of the spinal nerve passes above while the ventral branch passes below the heavy intertransversales fascia. This fascia is formidable enough to prevent an anesthetic solution from diffusing through it.

The dermatomes of the thirteenth thoracic and the first three lumbar spinal nerves were determined by transecting dorsal roots of spinal nerves as described by Sherrington. By photographing the area and transferring the area to figures it was shown that there is considerable overlapping of the dermatomes and that as many as three spinal nerves may innervate a particular area.

The area desensitized by transecting the dorsal lateral branches of the thirteenth thoracic and the first and second lumbar spinal nerves extended from near the dorsal midline to about the middle of the lateral abdominal wall. When the dorsal lateral branch of the third lumbar spinal nerve was cut in addition to the three mentioned above the area desensitized increased in size both posteriorly and ventrally.

The parietal peritoneum in animals in which a dermatome had been determined by Sherrington's method was slightly sensitive beneath the areas of non-sensitive skin but was extremely sensitive beneath the isolated dermatome.

The central pathway for sensory impulses was traced by following degenerating fibers. The number in the fasciculus gracilis decreased rapidly as the fasciculus proceeded up the spinal cord. No fibers could be traced into the nucleus gracilis.

In studying the effect of the various concentrations of anesthetic solutions on the pudendal nerve it was learned that procaine hydrochloride in concentrations of from three per cent to five per cent produced slight edema between the fasciculi of the nerve trunk. Hexylcaine hydrochloride in concentrations of four and five per cent produced a gelatinous appearance of the fat around the nerve and tended to produce more extensive edema between the fasciculi of the nerve trunk than procaine hydrochloride.

The clinical trials indicated that at times the ventral branches of the spinal nerves had not been blocked. Data collected during the clinical trials indicate that satisfactory anesthesia should be obtained with the Farquharson technique if careful attention is given to the following features in administering the anesthetic solution: a. A flinch should be obtained which occurs at the same distance or greater distance from the skin than the transverse process. b. The anesthetic solution should be injected between 6 mm. and 12 mm. posterior to the transverse process of the thirteenth thoracic vertebra and immediately posterior to the transverse process of the first and second lumbar vertebrae. c. Some of the anesthetic solution should be injected deep to the heavy intertransversales fascia in order to block the ventral branch of the spinal nerve being blocked. 137 pages. $1.71. Mic 56-1620

BIOCHEMICAL, PHYSICAL AND BACTERIOLOGICAL FACTORS INVOLVED IN FROTHY (FEED-LOT) BLOAT

(Publication No. 16,639)

Donald Richard Jacobson, Ph.D.
University of Maryland, 1956

Supervisor: Professor J. C. Shaw

The objectives of this study were twofold: (a) to obtain fundamental information regarding the cause of bloat and (b) to determine whether there was any possible relationship between bloat and rumen bacterial activity. This second objective involved the establishment of normal bacterial activity as well as any abnormal activity that may have developed when the animals bloated.

A combined approach was adopted. Rumen samples were taken from bloated and non-bloated control animals prior to, during, and at weekly intervals following changeover of the animals to the bloat producing diet. Each rumen sample was subjected to various biochemical, physical, and bacteriological treatments and analyses. These included the ingesta volume increase (IVI), stable ingesta volume increase (Stable IVI), Stable IVI with additives, per cent liquid phase, consistency index (CI), dry matter (DM), per cent of bacteria heavily encapsulated, relative concentration of iodine staining substance (ISS), presence of reducing substance, lactic acid, total volatile fatty acids, and the molar per cent of acetic, propionic, butyric, and valeric acids. In addition, bacterial cell suspensions were

prepared from each rumen sample. Twenty four hour incubations of an endogenous cell suspension and dissimilations of glucose and cellobiose added as substrates were carried out for each rumen sample. The fermentation liquors resulting from these incubations were analysed for residual substrate, ISS, lactic acid, total volatile fatty acids and acetic, propionic, butyric, and valeric acids.

Over 200 rumen samples were taken from 15 animals. Of an average of 4 animals at 4 and 74 days on the bloat producing diet, the bloat index increased from 2 to 13, the per cent liquid phase decreased from 21 to 0, the CI was variable, and was not correlated with DM of the rumen contents or the incidence of bloating. The IVI and Stable IVI values were frequently over 100 when the animals were bloating. The per cent bacteria encapsulated was 49 at 32 days on the bloat producing diet and increased to 71 at 74 days on the diet.

When the animals were placed on the bloat producing diet for 74 days, the concentration of rumen volatile fatty acids increased. The molar per cent of acetic acid decreased from 55 to 46% and then returned to 60%, propionic acid increased from 21 to 29% and returned to 20%, butyric and valeric acid percentages were variable. The dissimilation of glucose and cellobiose by rumen microorganisms showed that the proportion of fatty acids produced changed with the diet fed the animals. Following the changeover to the bloat producing diet, the dissimilation fatty acid proportions were altered in an accentuated manner in the same direction as the rumen fluid fatty acid proportions were altered with time on the diet. The synthesis of significant quantities of valeric acid by rumen bacteria was noted.

It was concluded that:

1. The bloat encountered in this study was uncomplicated frothy bloat. It resulted from a sufficient rate of production of stable froth in the rumen and reticulum which, by its presence in the area of the cardiac orifice blocked the eructation mechanism, partially or completely.
2. A number of factors that can contribute to the formation of stable froth are:
   (a) Sufficient adjustment of the rumen microflora to the diet fed to the animal.
   (b) A high degree of encapsulation of the rumen bacteria.
   (c) A high concentrate ration with a readily available source of energy to the rumen microorganisms.
   (d) The presence of any one or any combination of saponin, glucose, and valeric acid in the rumen contents.
3. A sufficient amount of stable froth appears to be produced in the rumen to cause bloat, when the right combination of a sufficient number of factors present themselves simultaneously.
4. The physical nature and the volatile fatty acid composition of the rumen contents changed with changes in the diet and was constantly changing for 74 days following placement of the animals on the bloat producing diet.
5. In terms of the in vitro dissimilations of glucose and cellobiose, the metabolic activity of the rumen bacteria changed with each diet and in the case of the bloat producing diet, was constantly changing for 74 days following changeover to this diet.
6. Rumen microorganisms were intimately associated with and contributed to the cause of frothy bloat.

163 pages. $2.04. Mic 56-1621

UTILIZATION OF CORN WITH HIGHER OIL AND PROTEIN CONTENT BY STEERS

(Publication No. 16,418)

Harold Hunter Pierce, Jr., Ph.D.
University of Illinois, 1956

Studies were conducted to study the utilization by steers of corn bred for higher oil and protein content. The shelled corn of this strain contained approximately twice as much ether extract as regular corn and a higher percentage of protein. Silage made from higher oil-protein corn grown under more favorable conditions could be expected to be superior to that used in these trials.

In Experiment I, the average daily gains of a lot of ten yearling steers fed higher oil-protein corn was approximately as much as the gains of steers in a lot which received approximately an equal amount of total protein in the form of additional soybean oil meal. Yearling steers on full feed did not gain faster on rations of higher oil-protein corn than those fed regular corn when the protein level was equalized.

In Experiment II, Trial 1, there was no significant difference in the daily rate of gain between pairs of steer calves which were individually fed balanced wintering rations containing higher oil-protein corn silage and those which were fed rations containing regular corn silage. In Trial 2, steer calves individually fed fattening rations of equal amounts of regular corn silage, a supplementary mixture of soybean oil meal, minerals and vitamins A and D did not gain at a faster rate on higher oil-protein shelled corn than those which were fed regular shelled corn.

In Experiment III, each of four mature steers was fed each of four experimental rations during eight collection trials to study the comparative digestibility of the ether extract and the digestibility and retention of the nitrogen of corn with higher oil and protein content.

Under the conditions imposed in these studies the following conclusions are made:

(1) The increased nitrogen of the kernel of corn bred for higher protein content was utilized by steers.

(2) The coefficient of digestibility of protein of corn bred for higher oil and protein content was not significantly different from that of regular corn when fed to mature steers at a level below full feed intake.

(3) The ether extract of higher oil-protein corn and higher oil-protein corn silage was digested as well as that of regular corn and regular corn silage when fed to mature steers at approximate maintenance levels.

(4) Steers which were fed higher levels of fattening rations refused to eat as much higher oil-protein shelled corn as those which were fed rations containing regular shelled corn.

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(5) The feeding of higher oil corn to fattening steers in order to obtain an increase in the rate of gain does not appear to be feasible on the basis of these trials.

Future increased use in cattle rations of corn bred for both high oil and high protein content seems dependent upon the efforts and success of the corn breeders in the improvement in yield, drought resistance and other desirable characteristics as well as selection for higher oil and protein content. 87 pages. $1.09. Mic 56-1622

AGRICULTURE, PLANT CULTURE

THE GENETICS AND PHYSIOLOGY OF FOLIAR DIEBACK IN THE GREENHOUSE SNAPDRAGON, ANTIRRHINUM MAJUS L.

(Publication No.. 16,739)

Charles Edward Ackerman, Ph.D.
Michigan State University, 1952

Several light intensities, light qualities, photoperiods, air temperatures, and soil temperatures in various combinations were established to determine the influence of these environmental factors upon the incidence of foliar dieback in the greenhouse snapdragon, Antirrhinum majus L. Several varieties of snapdragon were used in this study. Foliar dieback consistently occurred on the entire sample population of an isolated strain of variety Lady Dorothy when exposed to an air temperature of 40° F. or lower for a period of eight hours. The F_2 progenies of several crosses of which the isolated strain of Lady Dorothy was a parent showed dieback symptoms in the ratio of three normal to one dieback when exposed to a 40° F. air temperature for eight hours. Dieback occurred on the susceptible lines only when they were exposed to an air temperature of 40° F. or lower. The nature of the response of the susceptible genotypes indicates the expression of a single recessive gene under the influence of a low air temperature. 63 pages. $1.00. Mic 56-1623

PHYSIOLOGICAL STUDIES OF THE SWEETPOTATO (IPOMOEA BATATAS): PHASE I: EFFECTS OF CHEMICAL TREATMENTS ON SPROUT PRODUCTION. PHASE II: CHEMICAL INDUCTION OF FLOWERING.

(Publication No. 16,750)

Monticello Jefferson Howell, Ph.D.
Michigan State University, 1956

Two physiological studies of the sweetpotato were conducted during a three-year period from 1953 to 1955, inclusive. The first phase involved the effects of certain chemical treatments applied to the roots on subsequent sprout production for propagation purposes, whereas the second phase dealt with the chemical induction of flowering in sweetpotato plants representing several varieties from foliar applications of 2,4-dichlorophenoxyacetic acid. In 1953, maleic hydrazide (MH-30) and alpha-cyano-beta-(2,4-dichlorophenyl) acrylic acid (B-214) each at concentrations of 10, 100, and 1000 ppm were applied as aqueous solutions to roots of Porto Rico and Goldrush sweetpotatoes by injecting round toothpicks previously impregnated with the solutions containing the chemicals into the roots. Two control comparisons were used. One consisted of roots in which toothpicks previously impregnated with distilled water were injected, while the other involved sweetpotato roots which were not treated. The roots were bedded according to usual practices and the total number and weights of the sprouts as related to treatment and variety were recorded per bushel of bedded roots. Roots of Porto Rico, Goldrush, Yellow and Orange Jersey were similarly treated in 1954 with the sodium salt of maleic hydrazide (MH-40) at concentrations of 100, 250, and 1000 ppm; an emulsifiable concentrate formulation of alpha-cyano-beta-(2,4-dichlorophenyl) acrylic acid (B-214C) at concentrations of 10, 100, and 1000 ppm; and 2,4-dichlorophenoxyacetic acid (2,4-D) at 10 ppm.

No significant differences in total number of sprouts produced were found in 1953 between treatments. However, B-214 at a concentration of 1000 ppm significantly decreased the weights of sprouts produced by both varieties. Similarly, in 1954 marked differences in sprouting behavior were noted among varieties, but not from treatments. The anticipated improvement in sprout production was not realized in these tests.

Foliar sprays of 2,4-D in concentrations of 100 and 500 ppm, applied to Porto Rico and Goldrush sweetpotato plants in September, 1953, at the time of the initial enlargement of the fleshy roots successfully induced flowering 6 to 8 weeks later. Flowering was general and occurred among plants of both varieties which were treated at two different dates. Similarly, sprays of the sodium salt of 2,4-D from concentrations of 100 to 500 ppm were also effective for inducing flowering in plants of Porto Rico and Yellow Jersey varieties during the fall of 1954. Flowering was general and was associated with a significant depression of storage root growth. The distribution of flowering in the Porto Rico plants was from the 20th to the 64th nodes, whereas in Yellow Jersey it was from the 20th to the 74th nodes. Flowering in Porto Rico was greatest among plants which received 2,4-D at a concentration of 500 ppm; however, in the Yellow Jersey 100 ppm was best. Concentrations higher than 100 ppm inflicted severe injury on Yellow Jersey.

In 1955, the sodium salt of 2,4-D at concentrations of 100 to 500 ppm again proved effective for the induction of flowering in Porto Rico and Yellow Jersey plants. Of all the plants treated (irrespective of variety), thirty-eight percent flowered, with the greatest number of flowers occurring at 250 ppm. Flowers were more abundant with Yellow Jersey. In all cases, flowering was associated with a significant depression of fleshy root growth, and tumefactions at the nodes of the main stems and laterals were common. Impeded transport was apparent. An attempt was made to show if there was a relationship between flowering response in treated plants and carbohydrate-nitrogen metabolism in the leaves. Chemical analyses of treated and control plants showed no differences in total sugars in leaves collected 4 and 20 days after treatment either between varieties or among treatments. However, treatments with 2,4-D significantly decreased

total nitrogen in leaves collected 4 and 20 days after sprays were applied. 102 pages. $1.28. Mic 56-1624

OCCURRENCE AND TIME OF REPRODUCTIVE STRUCTURE DEVELOPMENT AND THEIR RELATION TO YIELD OF RUTGERS TOMATOES

(Publication No. 16,681)

John Thomas Kitchin, Ph.D.
Rutgers University, 1956

Studies concerning the fruiting behavior of Rutgers tomatoes were made during the four years 1952-1955. Inventories of reproductive structures produced on each of several plants were made several times during the first part of each season. At each inventory in 1952-53 each reproductive structure produced to date was identified and its morphological stage of development recorded. In 1954-55 inventories consisted primarily of counts of numbers of reproductive structures produced to date and the number in each of several morphological stages of development. A record of the fruit which attained red ripe maturity, including date and weight, was kept.

The number of buds produced per day in 1952 increased from about 3 or 4 in late June to about 30 in late August. It appears quite possible that some plants in some seasons may produce as many as 2500 buds, and perhaps more.

Of the buds produced through mid-July, 83 per cent in 1952 and 52 per cent in 1953 had dropped by mid-August.

The efficiency of buds which develop later in the season, as measured in number or percentage of them which mature fruit, is much lower than that of buds produced earlier in the season. About 14 per cent of the buds produced through mid-July matured fruit by September 30 and 18 per cent matured fruit before frost. Approximately 95 per cent of the fruit which matured by the end of September was produced by buds which were visible on the plant at or before mid-July.

Yields were significantly correlated with reproductive structure development as early in the season as mid-June. The suggestion is offered that measurements of reproductive structure development early in the season may be useful in predicting the potential yield of Rutgers tomatoes. The easiest and quickest reproductive structure measurement to make is number of clusters. Since coefficient of correlation and coefficient of regression values for this measurement were significant at the one per cent level it appears to be the most practical single measurement for this purpose. 89 pages. $1.11. Mic 56-1625

COMPARATIVE STUDIES OF RACES 49 AND 139 OF PUCCINIA GRAMINIS VAR. TRITICI ERIKSS. AND HENN.

(Publication No. 16,559)

Hosni Abdel Rahman Mohamed, Ph.D.
University of Minnesota, 1956

Races 49 and 139 of the stem rust fungus, Puccinia graminis var. tritici Erikss. & Henn. can be differentiated on Marquis and Kota wheats among the 13 standard differentials at 60° to 72°F. Marquis and Kota are susceptible to race 49 and resistant to race 139. At temperatures higher than 80°F., race 139 phenotypically resembles race 49 and cannot be differentiated from it. Among 85 wheats, 11 barleys, 2 oats and one rye, no better differential than Marquis and Kota was found. Pilot, Ceres, and L.D. 53 durum wheats were as good as Marquis and Kota. Pilot can be used at temperatures 3° to 5°F. higher than Marquis or Kota. On 75 per cent of the wheat lines tested the two races resembled each other in pathogenic capabilities.

Both races comprise several biotypes or sub-races that differ in pathogenicity. Two sub-races were demonstrated in race 49. At 80°-85°F., Minturki is resistant to race 49A but susceptible to race 49B; at 65°F. Selkirk is susceptible to race 49A but mesothetic to race 49B. Three were demonstrated within race 139 on Kentana 52 and Rushmore wheats: Kentana 52 is resistant to 139 A and susceptible to 139B; Rushmore is resistant to A and B groups, but susceptible to the third group (C + D). The third group (C + D) can be further differentiated on Timstein or Lee wheats which are resistant to 139C and susceptible to 139D at 72° to 90°F.

Physiological characters are of little use in differentiating the two races. Slight and temporary differences among isolates were found in urediospore germination in distilled water at 77° F., in formation of appressoria at 70°-77° F. and in infection of some wheat varieties. On seedling leaf surfaces, spore germination was better on Arnautka and Lerma 52 than on Marquis and Kubanka. More infection centers developed per leaf on these seedlings after inoculation at 70° to 87° F., than at 54° F. The most infection centers occurred on seedlings kept 24 hours in moist chambers at 66° to 80° F.

Race 49A and race 139B produced flecks on nine wheat varieties within 4 to 5 days between 73° and 97° F. and developed more rapidly than race 49B and race 139A. The two latter developed best at 87° F. and were more rapid on Marquis, Kubanka, Little Club, and Kenya 58 than on McMurachy, Lerma 52, Kota, Pilot, or Timstein.

Temperature at which seedling reactions changed from resistance to susceptibility was specific for each variety x rust-isolate combination.

The lethal temperature for mycelium of these rust isolates was near 97° F. Necrotic flecks as well as normal uredia often appeared at 92°-97° F. At 101° F. and above, mycelium of some isolates was completely inhibited but mycelium of race 139A survived 5 days at 105° F. in seedlings of Kota, Lerma 52 and Marquis wheats.

Urediospores of race 139B survived for 10 days on dry foliage of Marquis and Little Club seedlings in greenhouses with high midsummer temperature and light. At 72° F., no visible infection appeared on Lerma 52 inoculated with race 139A, but rust mycelium survived for at least 19 days, and sporulated 2-3 days after plants were transferred to 85° F.

Light intensity was secondary to temperature in affecting rapidity of flecking, growth of mycelium, sporulation, infection types produced and host cell chlorosis and necrosis.

Post-inoculation temperatures determine the reaction of Lerma 52 to race 139A, but there are indications that pre-inoculation temperatures as high as 85° F. may predispose Lerma 52. The variety is resistant to 139A if pre-inoculation temperature is 70° F. and post-inoculation

temperature is 74° F.; but it is mesothetic if pre-inoculation temperature is 85° F. and post-inoculation temperature is 74° F. 126 pages. $1.58. Mic 56-1626

NUTRITION OF THE STRAWBERRY (Fragaria spp.) WITH SPECIAL REFERENCE TO FOLIAR ABSORPTION OF RADIOPHOSPHORUS AND CALCIUM

(Publication No. 16,743)

Robert Alan Norton, Ph.D.
Michigan State University, 1954

The Robinson strawberry was used to study the comparative efficiency of utilization of radiophosphorus (P^{32}) and radiocalcium (Ca^{45}) when applied to the foliage and to the roots. Plants were grown in sand culture in the greenhouse, using variations of the Hoagland nutrient solution. For foliage treatments individual leaves were dipped, and root treatments consisted of pouring the fertilizer solution around the base of the plants at least two inches from the crown. Through the use of autoradiography and isotope dilution analysis to determine changes in relative specific activities of P^{32} and Ca^{45} it was shown that P^{32} was readily translocated to non-treated parts, especially developing leaves, fruits, root tips and runner plants from both foliage and root applications at a similar rate of movement. In contrast to P^{32}, translocation of Ca^{45} from foliage application was negligible. When applied to the roots Ca^{45} was readily absorbed and translocated to all plant parts including runners but there was little movement into the roots of the attached runner plants. With respect to the efficiency of leaves and roots in nutrient absorption, the uptake of P^{32} from the leaves was less affected by the phosphate level at which the plants were grown than was absorption from the roots. The rate of foliar uptake of three nitrogen-phosphorus carriers—mono- and di-ammonium phosphate and phosphoric acid plus urea—was studied using radiophosphorus and it was found that the phosphoric acid-urea combination was most readily absorbed and utilized. In a study of the influence of the temperature of the root medium on plant growth and absorption of radiophosphorus by leaves and roots it was found that dry weight production by leaves was greatly reduced as the root temperature decreased from 75° F. to 45° F. while dry weight of roots was reduced very little. A highly significant reduction in P^{32} uptake by the roots occurred as the temperature was decreased from 55° to 45° F. while absorption and translocation of foliar-applied P^{32} appeared to be less influenced by the temperature of the root medium. Similar long-term experiments with the roots of the strawberry maintained at various temperatures showed no advantage of foliar applications of nitrogen and phosphorus to plants growing at low (50° F.) root temperatures as compared to the same nutrients applied to the root medium.

In limited field experiments in southwestern Michigan foliage applications of urea, phosphoric acid, di-ammonium phosphate and a commercial product, Bonro (10-50-10) were tested on a number of strawberry plantings. Pre-bloom and post-bloom foliar applications of fertilizer were made to both the Robinson and Premier varieties in addition to the growers regular fertilizer program. A yield increase was obtained in only one location of low fertility, with no increase on plantings receiving adequate soil fertilization. It was concluded that foliage applications of fertilizer to strawberries in early spring would be advantageous only when an inadequate soil fertility program is followed. 153 pages. $1.91. Mic 56-1627

THE EFFECT OF THE DELAY ACCOMPANYING THE USE OF THE COMBINE HARVESTER ON THE PHYSICAL AND CHEMICAL PROPERTIES OF SOFT RED WINTER WHEAT

(Publication No. 16,486)

Mart Pool, Ph.D.
Purdue University, 1956

Major Professor: Fred L. Patterson

A number of changes in wheat during the delayed harvest period were studied to determine the significant changes which occurred, the importance of these changes to commercial quality, and to determine if differences between varieties occurred which would be of selection value in wheat by breeding.

In field experiments samples were harvested every few days over about a 45 day period following normal ripening. Grain quality was determined by applying tests commonly used for small samples and by analysis of fewer larger samples by the Federal Soft Wheat Laboratory.

There was ample evidence that delayed harvest had marked effects. Increases in granulation, pearling, and break flour yields indicated significant improvements in grain quality. Total flour yield, protein content and ash content were unchanged. Viscosity index, mixogram area and cooky quality were affected sometimes but trends were difficult to establish. Significant differences between varieties and significant interactions between varieties and the length of the delayed harvest period indicated the possibility of varietal improvement by breeding and selection.

Loss of test weight of grain was marked. Loss of kernel weight accounted for little of the loss in test weight. Since differences between varieties and length of the delayed harvest were not obtained, selection for the highest test weight at the normal harvest season should be as effective as selection at later periods.

Varieties differed in the rates at which they sorbed and lost moisture in field and laboratory studies. Differences were due mainly to differences in kernel structure rather than to chemical differences.

Two plant morphological characters had important effects on moisture sorption and loss in the field and are of selection value in wheat breeding. In studies of near isogenic lines except for awnedness or awnlessness, awns permitted faster drying under field conditions. Nonwaxy glumes permitted faster drying than waxy glumes under field conditions though the initial moisture content of grain was higher.

A laboratory technique was developed to simulate the changes that occur during delayed harvest. Alternate short soaking periods (3 or 2 hours) in aerated deionized water at room temperature with drying periods of 24 hours at 43 degrees C had the same effect on kernel structure as measured by pearling indices as delayed harvest in the

field. Three soaking periods gave the same effect as 6 or 7 weeks of delayed harvest.

Delayed harvest provided exceptional materials for studying the basic factors involved in the fermentation time test for quality. Sunshine and moisture relationships accounted for most of the great variability of fermentation time on delayed harvest samples. Evidence indicates that proteolytic enzymes have the major role in breaking down the doughball and that diastatic activity has a subordinate role.

Evidence is presented to support the hypothesis that pearling indices measure density and coarseness of internal kernel structure and the elasticity and plasticity of cell walls while granulation indices measure fine flour production. 213 pages. $2.66. Mic 56-1628

THE EFFECTS OF LEGUME AND NON-LEGUME WINTER COVER CROPS ON THE GROWTH, QUALITY, AND NITROGEN NUTRITION OF MARYLAND TOBACCO

(Publication No. 16,645)

George Louis Steffens, Ph.D.
University of Maryland, 1956

Supervisor: Dr. O. E. Street

A field experiment was conducted at the University of Maryland Tobacco Experimental Farm to evaluate the effects of legume and non-legume winter cover crops on the growth, quality, and nitrogen nutrition of Maryland tobacco. Ten treatments were involved; i.e., two non-legume cover crops, two legume cover crops, four legume-non-legume cover crop combinations, one non-legume with added fertilizer nitrogen, and one with no seeded cover crop.

Generally vetch as a cover crop produced the highest yields and dollar per acre returns for the 5-year period. The combination cover crops were intermediate and ryegrass and wheat were the lowest. Tobacco quality, as indicated by value per hundred pounds, was generally best following the combination cover crops. The effects of the cover crops were less pronounced the first years of the test. In the drier years cover crops containing legumes produced the best tobacco. Chemical investigation of soil-plant relationships for the last two seasons showed that the amount of total nitrogen contained in roots and tops of vetch was 188 pounds per acre, combinations from 120 to 167, and non-legumes no more than 57. The dry matter yields of cover crops when roots and tops were combined did not differ as widely as when tops alone were considered. For the drier 1953 and 1954 seasons, the dollar per acre return increased as more nitrogen was incorporated into the soil.

Weekly soil pH values showed a slight decrease during the middle part of the two growing seasons. Graphic presentations of concentrations of nitrate nitrogen of soil and of tobacco midribs indicated that a good relationship existed between the two. Peaks in the concentration curves for both usually occurred near the middle of the growing seasons, with accumulation being greater for the drier of the two seasons. For both plants and soil, nitrate accumulation was greater following cover crops which contained higher amounts of nitrogen.

No important differences could be detected in the total nitrogen of soil following the four cover crops for either of the two seasons.

The percentages of total nitrogen, acid insoluble nitrogen, and total alkaloids of cured leaf tobacco were greater following those cover crops which contained higher amounts of nitrogen. The percentage of total and acid insoluble nitrogen increased from the bottom to the top of the plant. The bright grades contained the highest percentage of total alkaloids. Nitrogenous constituents were higher in the 1954 crop (drier season) than in the 1953 crop.

A paper chromatographic method for the determination of total alkaloids was statistically compared with the ultraviolet absorption method and correlation coefficients were found to be significant.

Fire-holding capacity tests, as well as burn and aroma ratings, of the bright grade showed that tobacco following cover crops containing legumes was better than tobacco following non-legumes for the 1953 and 1954 seasons.
120 pages. $1.50. Mic 56-1629

MANGANESE AND PLANT ACIDITY INTERACTION IN THE GROWTH OF PLANTS IN WATER CULTURE

(Publication No. 16,502)

Lester Jay Zimmerman, Ph.D.
Purdue University, 1956

Major Professor: Alvin J. Ohlrogge

Manganese deficiency and toxicity symptoms in plants are known to be affected by light and temperature. In general the reduction of light intensity intensifies manganese deficiency symptoms and reduces manganese toxicity symptoms. Organic acid production and accumulation in the plant also varies with climatic factors. Low temperatures and dim light increase plant acidity. Organic acids form complex compounds including chelates with heavy metal ions and thereby reduce the activity and availability of the ions. It was postulated that the effect of light and temperature on manganese deficiency and toxicity symptoms operates through the influence of these factors on plant acidity.

Plants of different total acid content were produced by growing them under different conditions of temperature and day length, and by supplying them different sources of nitrogen. Oats, spinach, and soybeans were grown in water cultures in the Purdue Controlled Climate Facility. Four to six plants were placed in two-liter Pyrex beakers as soon after germination as possible. Low, medium, and high levels of manganese concentration were maintained. The complete nutrient solutions were changed frequently. Iron was supplied as the ferric complex of ethylenediamine tetraacetic acid at 5 ppm and was found to be a very satisfactory and lasting source. Air was bubbled through the cultures continuously.

Oats and soybeans were harvested seven to nine weeks after germination. Flowers and fruiting bodies were usually visible. Spinach was 12 to 13 weeks old and had eight

to ten leaves unfolded at the time of harvest. The samples were separated into tops and roots and treated with hot water within ten minutes after cutting. They were then macerated in a Waring blendor. After dilution to a standard volume, each sample was brought to a pH value of 9.0 with dilute sodium hydroxide. The total acid content was determined by titrating the macerated sample in a water suspension with 0.2 normal hydrochloric acid between pH values of 9.0 and 2.5. The samples were subsequently analyzed for total manganese and iron content.

Plants of higher acid content were produced with lower temperatures and shorter photoperiods. However, the differences were small. Greater differences in acidity were produced with different nitrogen sources and at the same time more nearly similar plants were grown. Plants grown with nitrate nitrogen contained more acids than plants grown with ammonium nitrogen.

The manganese content in the plant increased as manganese concentration in the substrate increased. The rate of increase was greater in plant roots with higher acid content. In the tops the rate of increase was the same for the different levels of acidity. As manganese content increased, iron content decreased. At high manganese levels the rate of decrease in iron content was smaller than at low levels of manganese. The iron content was greatest in the plants of lowest acidity for all manganese levels.

The iron-manganese ratio of the tops approached unity for maximum growth. The ratio was slightly lower in the plants of low acidity. For the roots the greatest growth occurred when the ratio was between three and four. The iron content of the roots was 20 to 30 times greater than the tops.

Manganese deficiency symptoms appeared first and were more severe in plants of lowest acidity. These plants also required higher concentrations of manganese to produce maximum growth. This indicates that increased acidity aids in the translocation of manganese to the points of active leaf and stem growth.

Plants with highest acidity tolerated a wider range of manganese concentration. Spinach grown with 25 ppm manganese made good growth when the acid content was greatest. The plant roots with the greatest amount of acids contained the highest amount of manganese. This indicates that increased acidity reduces the mobility and activity of manganese ions when they are in excess.

The mechanism whereby organic acids influence the manganese activity within the plant and, hence, the manganese deficiency and toxicity symptoms, may be through their role as chelating agents. By chelation the acids improve the translocation of manganese when the manganese concentration is at a minimum. At high concentrations of manganese, ionic acitivity is reduced by the formation of chelates when the acid content is greatest. Thus, the evidence indicates that the organic acids help maintain an optimum level of manganese activity in the plant so that adequate enzyme activity and maximum growth can occur.

122 pages. $1.53. Mic 56-1630

ANATOMY

THE PHRENIC NUCLEUS IN THE CAT AND MAN

(Publication No. 16,556)

Nandkumar H. Keswani, Ph.D.
University of Minnesota, 1956

The location and the structure of the phrenic nucleus of the cat and man has been studied in appropriately prepared spinal cords.

In nine adult cats chromatolysis was induced in the cell bodies giving rise to the motor fibers of the phrenic nerve by sectioning the roots of this nerve, which in the cat arises from the fifth and sixth ventral cervical rami. Then serial frontal sections 50μ thick were stained with thionine, and projections of the sections were traced.

Ten human spinal cords, obtained from the bodies of persons on whom unilateral phrenicotomy had been done 6 to 120 days before death were studied for chromatolytic changes. Serial frontal sections 40μ thick were stained with cresyl violet, and projections of the sections were traced.

From these projections, composite frontal and transverse sections at three different levels of the nucleus, both in the cat and in man, were constructed.

It was observed that the phrenic nucleus in the cat extends throughout the fifth and sixth cervical segments, lying between the ventrolateral and the ventromedial groups of cells. In man, this nucleus occupies the most medial portion of the ventromedial group of cells in the ventral gray horn of the third, fourth and fifth cervical segments. It is, in both the cat and man, a straight, very discrete column of longitudinally oriented cells of medium size, lying almost parallel to the ventral longitudinal fissure of the spinal cord, despite the lateral expansion of the ventral gray horn as the cervical enlargement develops.

The organization of the phrenic nucleus was studied in silver-stained serial frontal and transverse sections of the cervical portion of spinal cord of the cat and man, and its structure compared with that of other cell groups in the cervical, thoracic and lumbar regions of the spinal cord.

The phrenic nucleus, in the cat and in man, is characterized by the orientation of its somewhat fusiform cell bodies in the longitudinal axis of the spinal cord, and by a particularly marked similar orientation of the dendrites of these cells, which form a compact tract about the cells of this nucleus.

While there is much confusion regarding the cell groups of the ventral gray horn of the spinal cord and little agreement as to the precise functional importance of the various cell groups, the phrenic nucleus is an example of a clear-cut anatomic grouping of motor neurons supplying a discrete muscular mass.

The apparent structure of the nucleus suggests that the crossed phrenic phenomenon is a result of crossing of axons of reticulo-spinal pathways, not of the dendrites of

the phrenic cells, at the level of the nucleus. The compact nature of the dendritic tract likewise suggests that this grouping of dendrites allows close contact of the incoming axons with a number of cells simultaneously, and this presumably explains the linkage of the cells of the nucleus that has been suggested by physiological studies. The only other cell groups of the spinal cord which have been reported to have a structural organization resembling that of the phrenic nucleus are ones which are known or supposed to act largely as a unit, thus indicating a close correspondence between the structure of these groups and their functions. 88 pages. $1.10. Mic 56-1631

ANTHROPOLOGY

LANGUAGE AND NON-LINGUISTIC BEHAVIOR: AN EXPERIMENTAL INVESTIGATION

(Publication No. 16,573)

Howard Stanley Maclay, Ph.D.
The University of New Mexico, 1956

This dissertation is an experimental investigation of the proposition, developed by Edward Sapir and Benjamin Whorf, that language conditions non-linguistic behavior. It also considers some of the more general problems involved in experimentation which attempts to compare the behavior of persons with different cultural backgrounds.

An introductory section discusses the antecedents of the Sapir-Whorf hypothesis in an effort to show that the idea of language having an influence on thought is an old one. The particular version of this position which Sapir first stated and Whorf later supplemented is associated with two prior traditions, a German and European school of thought having von Humboldt as its major exponent and the work of Franz Boas on American Indian languages and cultures. Later formulations of the hypothesis, especially that of Hoijer, are examined and evaluated.

The research employs experimental methods to investigate a general proposition. More specifically, it is supposed that a connection will be found between certain aspects of the Navaho language and the behavior of Navahos in an experimental situation. The Navaho verb system contains an obligatory classification of objects on the basis of their form. Three of these categories are selected and incorporated in the experimental material. Subjects are given an option of sorting materials either in terms of the Navaho verb categories or on some other basis. Three groups of subjects are compared: native speakers of English, of Navaho, and of a variety of non-Athapascan southwestern Indian languages. It is predicted that Navahos will differ from the other groups with respect to the two scores, sorting and latency, obtained for each subject performance.

The results are mixed in terms of their bearing on the question being investigated. Some of the specific hypotheses made were clearly supported; others were not confirmed. This is interpreted as an indication that the logic underlying the experiment had not been entirely consistent. The results and therefore re-examined in terms of a second look at this logic. A typology of hypotheses is offered which distinguishes between predictions that involve absolute between-group comparisons and those which refer to relative within-group comparisons. This classification provides a basis for evaluating the hypotheses made in advance of the experiment. It is finally concluded that this experiment has shed considerable light on the relation of language to other forms of behavior, even though the overall results do not consistently confirm or deny the postulated association between language and non-linguistic behavior.

A final section presents a number of general considerations in an attempt to define more exactly the factors involved in cross-cultural experimentation on language. Two levels of linguistic data, language structure and language behavior, are defined and the relation of these to experimental designs is discussed. The use of obligatory categories is suggested as one way of relating these levels for experimental purposes. The semantic content of linguistic categories is described in terms of reference rather than meaning to avoid some of the difficulties arising from an estimation based on English translations. It is further contended that the classification of stimuli contained in a language is not a simple cutting up of the universe into neat and mutually exclusive segments. Rather, any stimulus can participate in a number of intersecting linguistic categories. These and other distinctions follow from the results obtained in the experiment.

The more practical implications of this research for future experimentation are examined, and some suggestions and cautions with regard to subjects, materials, and procedure are presented.

101 pages. $1.26. Mic 56-1632

CYTOCHEMICAL AND BIOCHEMICAL COMPARISONS OF LIVER NUCLEI OF NORMAL AND EQUINE ABORTION VIRUS-INFECTED HAMSTERS

(Publication No. 16,576)

Everett C. Bracken, Ph.D.
Vanderbilt University, 1956

Supervisors: Professors Charles C. Randall and Robert J. Neff

The present investigation was initiated in the belief that, following viral infection, progressive histological and cytochemical changes in hepatic cells of mammalian liver could be accurately determined. It was anticipated, too, that correlations between histological and cytochemical findings might lead to a better understanding of the parasite-host cell relationship.

Equine abortion virus produces a striking hepatitis in hamsters, culminating in death in 18 to 24 hours. A characteristic intranuclear inclusion appears in practically all parenchymal cells. The inclusion bodies stained Feulgen positive throughout the intervals studied. The constancy of the infection and the nature of the lesion indicate that the hamster liver is an excellent medium for the study of a specific animal virus.

Livers of young hamsters, infected with equine abortion virus, were collected over a period of 15 hours at 3-hour intervals, and in some cases from animals in terminal stages of infection. All samples were represented by pooled livers of at least 5 hamsters. Controls consisted of livers from uninoculated hamsters and from hamsters injected with suspensions of normal liver and sacrificed at 3-hour intervals. The hepatic cell nuclei were isolated in citric acid, enumerated, lyophilized, and weighed.

Nucleic acids were extracted in 5% trichloroacetic acid at 90°C for 15 minutes. The nuclear content of desoxyribonucleic acid (DNA) was estimated by use of the Dische diphenylamine reaction and the intensity of the color produced was measured in a Beckman spectrophotometer. The content of ribonucleic acid (RNA) was measured by the orcinol reaction; the colorimetric response also was measured spectrophotometrically. Nuclear proteins were determined quantitatively by the biuret reaction, using edestin as a standard for comparison. Weights of nuclei, nucleic acids, and nuclear proteins were expressed as mg x 10^{-9} per nucleus.

The average weights of nuclei from uninoculated controls did not vary materially throughout. No significant change in weights of infected nuclei occurred during the first 9 hours, but increased to 90.0 between 9 and 15 hours. Weights of nucleoproteins closely paralleled weights of nuclei at corresponding intervals. RNA did not change materially from 2.98 at 0 hours (uninoculated control) until after 9 hours subsequent to inoculation. Between 9 and 12 hours the RNA increased to 4.32 and remained at this level between 12 and 15 hours. DNA averaged 10.70 both in control and infected cell nuclei. The finding of increased weight of nuclei and of increased RNA and nucleoproteins resulting from infection with an animal virus is unusual, if not unique. 98 pages. $1.23. Mic 56-1633

BOVINE STAPHYLOCOCCAL MASTITIS

(Publication No. 16,549)

Richard Wallace Brown, Jr., Ph.D.
University of Minnesota, 1956

Major Adviser: Martin H. Roephe

A study of some of the characteristics of pathogenic staphylococci isolated from the udders of dairy cows revealed that within the same herd some of the organisms isolated from different cows showed varying abilities to produce alpha and beta toxins. In addition, organisms with different toxigenic properties were isolated from different quarters of the same udder as well as from the same quarter at different times.

A comparison of the organisms from two different herds showed that a greater percentage of the organisms from herd A produced more beta than alpha toxin, whereas, the opposite was true for a greater percentage of the organisms from herd B.

A difference was found in the titration patterns of alpha, beta toxin producing organisms tested in 1949 and those tested in subsequent years. No conclusive reason for the change in titration patterns could be determined.

No apparent relationship was found between the toxigenic properties and the bacteriophage pattern or the sensitivity to several antibiotics for the staphylococci studied.

The average level of alpha and beta antitoxins and agglutinins in the serums of 34 cows which had staphylococcal infected udders increased according to the number of quarters infected. This relationship was not consistent for individual cows. Other factors are discussed as means of influencing the level of antibody in the blood of cows with infected udders.

A comparison of the levels of alpha and beta antitoxins in the serums of the 34 cows showed that none of the cows from herd A possessed an alpha antitoxin titer greater than the beta antitoxin titer, whereas, in herd B, 82 per cent of the cows had higher alpha than beta antitoxin titers.

In a third herd, the average alpha and beta antitoxin titers were highest in those cows with staphylococcal infected udders, lower in the cow in which udder infection had disappeared, and lowest in those cows whose udders were never infected with the organisms. In the cows with noninfected udders, there was a tendency for the antitoxin titers and the number of serums which showed evidence of antitoxins to increase with the age of the animals and reach maximum levels during the second lactation period. There also was found a greater incidence of alpha than beta antitoxin in the cattle tested.

In seven cows with acute staphylococcal mastitis, the

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

highest antitoxin titers were not necessarily associated with the more severe cases of mastitis. The serum agglutinin titers in the same cows did not necessarily follow a similar pattern of development as the antitoxins.

In 42 cases of mastitis which developed in 32 cows, it was found that acute mastitis was more apt to develop when the infection was new or recent and when there was no previous history of clinical mastitis; whereas, subacute mastitis was found associated predominantly with chronic infections and in cows having a previous history of clinical mastitis. Although subacute mastitis did not occur more frequently in any particular lactation, a greater incidence of acute cases of mastitis and clinical cases of mastitis attributed to new infections were found during the first lactation. It was found that the presence of antitoxins did not necessarily protect against the development of clinical mastitis; however, the data were interpreted to indicate that the presence of antitoxins may have prevented the development of more severe symptoms. A comparison of the toxigenic properties of the infecting organisms indicated that the toxin producing abilities of the organisms were not always reflected in the type of mastitis which developed, although, only very good toxin producing organisms were associated with the acute systemic cases of mastitis.

The vasoconstrictive action of staphylococcal alpha toxin as a cause of gangrene and associated symptoms in acute staphylococcal mastitis is discussed.

120 pages. $1.50. Mic 56-1634

THE BIOSYNTHESIS OF HYALURONATE BY GROUP A STREPTOCOCCI

(Publication No. 16,572)

Yael Ginzburg, Ph.D.
University of Minnesota, 1955

Major Advisor: Professor Dennis W. Watson

Physiological conditions required for the synthesis of hyaluronate were determined in an effort to find a rapid and simple method for the isolation of streptococcal hyaluronate in its native form.

Several strains of group A streptococci were passed in rabbit skin and their ability to synthesize hyaluronate was assayed before and after passage. The experimental results showed that the transformation from the glossy to the mucoid phase is usually accompanied by an increase in hyaluronate production.

By employing "washed cell suspensions" of these mucoid group A streptococci, we were able to isolate a hyaluronate-protein complex which is believed to simulate the streptococcal capsule. The antigenicity of hyaluronate is somewhat equivocal, but antibody probably is directed against the protein moiety of the mucopolysaccharide. The isolated hyaluronate gave a single component upon electrophoresis, indicating a fair degree of purity. A positive protein test on the isolated electrophoretic component showed that the hyaluronate existed as a complex with the protein moiety. This protein portion when isolated from the complex gave a positive precipitin test with known anti-M sera. These results indicated that the M-protein existed as a complex with the hyaluronate. It was shown that hyaluronate biosynthesis, in "washed cell suspensions", depended upon a multiplicity of factors including the age of the culture, the initial pH of the growth medium and the presence of optimal concentrations of substrate. A glucose stabilizing effect was observed in the system and the synthesizing enzymes were shown to be labile at acidic pH values. An interesting effect on the production of hyaluronate was observed in the presence of penicillin. Incorporation of penicillin into the system influenced the production of hyaluronate. An increase of hyaluronate production was noticed, in the case of type 28 group A streptococci, when the amount of glutamine provided for the cell was reduced below the optimal level. One might assume that penicillin interfered with other metabolic pathways which utilize glutamine, thus increasing the glutamine pool within the cell. The possibility that the variation in hyaluronate production was a reflection of the presence of glutamine in the medium and the size of the glutamine pool within the cell was discussed.

By establishing the physiological conditions required for the biosynthesis of hyaluronate by "washed cell suspensions", we also were provided with a convenient system for studying the mechanism of hyaluronate synthesis. By the use of radio-active tracers, such labeled reagents could enable one to determine the retention and manner of elimination of capsular hyaluronate from animal tissues infected with group A streptococci. The role of the hyaluronate M-protein complex as a potential virulence factor in the non-suppurative sequelae, including rheumatic fever, was postulated. 133 pages. $1.66. Mic 56-1635

THE GROWTH OF GROUP A HEMOLYTIC STREPTOCOCCUS IN THE STEADY STATE

(Publication No. 16,329)

Victor Francis Iacocca, Ph.D.
University of Pennsylvania, 1956

Supervisor: Z. S. Harris

The steady-state growth of Group A hemolytic streptococcus has been investigated using the continuous-culture technique, i.e., continuous dilution at constant volume. The apparatus and medium developed for this purpose together with the associated operating procedures are described in detail. It has been possible to establish steady-state growth over a wide range of growth rate, 0.25 to 1 hr^{-1}, and to maintain the steady-state conditions for at least 78 generations.

Some features of the steady-state cultures have been studied for pH-limited growth, glucose-limited growth and tryptophan-limited growth. In the first case there is a characteristic relation between the growth rate and the steady-state pH. The rate of glycolysis has been found to decrease less rapidly with pH than does the growth rate with the result that the efficiency of utilization of glucose increases with increasing growth rate. The metabolite-limited cultures have higher, and non-characteristic, pH values than the pH-limited cultures. The metabolite-limited cultures reveal several distinctive properties which can be related to the low steady-state concentration of the limiting metabolite. 37 pages. $1.00. Mic 56-1636

STUDIES ON THE NEUTRALIZATION OF COLORADO TICK FEVER VIRUS

(Publication No. 13,772)

Robert Arthur Siem, Ph.D.
University of Colorado, 1955

Supervisor: Associate Professor Stuart G. Dunlop

The neutralization of a virus by its homologous immune serum involves a number of factors which are not clearly understood. Among these are, the choice of the indicator host, the route of inoculation, the source of virus, the host species supplying the antiserum, the time and temperature of incubation prior to testing, and the effects of nonspecific serum components which may alter the reaction between virus and specific antibody. This study is an attempt to clarify the role of several of these factors in the neutralization of Colorado tick fever virus by immune serums obtained from hamsters and human convalescents.

Initially, the virus was adapted from a suckling mouse strain to 21-day-old albino mice which could be obtained in the larger numbers required. This was accomplished by serial passage through mice of increasing age until a predictable lethal dose was established. Concurrently, the virus was adapted to increasing holding periods at 37° C prior to passage in order that a study could be made of the optimal in vitro incubation time of virus plus immune serum. It was determined that optimal neutralization was obtained following 4 hours of incubation in a 37° C water bath. At 2 hours of incubation the neutralizing efficacy was less by a factor of 10. It was found that the titer of the virus decreased at this temperature, 1 log at 24 hours, 2 logs at 36 hours, and 3 logs at 48 hours. To maintain the viability of the virus, it was found that undiluted normal rabbit serum was superior to 2 per cent bovine serum albumin or 10 or 20 per cent normal rabbit serum saline, as the diluent during storage at -40° C.

Several investigators have shown that a logarithmic relationship exists between the amount of virus neutralized and the serum dilution end point. Similar results were obtained in this study. A logarithmic plot of the data gave a line the slope of which approximates 1.0. This would indicate that the rate-controlling process for the neutralization of virus is the reaction of one antibody molecule with one virus particle. In addition it was found that the neutralizing efficacy of immune serum showed a significant increase correlated with a rise in the LD_{50} titer of the virus. Conversely, a lowering of the neutralizing efficacy in proportion to the loss of viable virus during storage, was observed.

Studies by other investigators have been at variance as to the role of complement, or some other thermolabile serum component, in the neutralization of viruses by their specific serums. It was shown in this study that inactivated immune hamster serum was equally effective, with or without fresh guinea pig serum, in neutralizing the virus of Colorado tick fever. Human convalescent serums, fresh or inactivated and with or without fresh guinea pig serum, showed comparable neutralizing efficacy. Therefore, it was concluded that complement or other thermolabile serum components do not enhance the neutralizing capacity of immune hamster or human serums against Colorado tick fever virus. Furthermore, serums may be stored at either 4° C or -40° C without loss of neutralizing efficacy.

153 pages. $1.91. Mic 56-1637

BIOLOGY, GENETICS

THE EFFECTS OF X-RAYS AND THERMAL NEUTRONS ON DORMANT SEEDS OF TOMATO

(Publication No. 16,568)

Paul Kiyoshi Yagyu, Ph.D.
University of Minnesota, 1956

The effects of X-rays and thermal neutrons on dormant seeds of the tomato variety, Puck, were studied with respect to chromosomal abnormalities in root tip mitoses, seedling injury in the immediate generation, chlorophyll and morphological abnormalities in the immediate and next generations. The dosage range for X-ray was from 6000 to 16000r and for thermal neutron from 12.83 to 77.00 X 10^{12} thermal neutron per cm^2.

For the study of chromosomal abnormalities, seeds were germinated in an alternating temperature germinator. The seeds with the root tip intact were fixed in modified Carnoy's fixative and the chromosomes were stained with propiono-carmine.

The seedling injury was assessed by the measurement of the first two leaves of the plants when grown in gravel greenhouse benches. These plants were transplanted into the field and seed was obtained for the X_2 and N_2 generations which were grown in sand greenhouse benches.

Chromosomal abnormalities were observed as bridges and fragments in the anaphasic stage of root tip mitoses of germinated seed. The bridges per cell were 0.75 for the combined X-ray doses and 0.98 for the combined thermal neutron doses. The fragments per cell were 2.32 for the combined X-ray doses and 3.70 for the thermal neutron doses. The slopes of the regression lines for bridges, although statistically different were so strikingly similar that, biologically, the regression lines should be considered to have the same shape. There were 62.25 per cent abnormal cells in the X-rays series and 80.79 per cent in the thermal neutron series. The regression line for per cent abnormal cells in the thermal neutron series was curvilinear and linear for the X-ray series.

There was an increase in the chromosomal abnormalities when the post-irradiation period was increased. The average numbers of bridges per cell for the combined X-ray doses were 0.75, 0.92, and 1.17 for 10, 224 and 322 days after X-raying, respectively. The fragments per cell increased from the first to the second germinations but showed a slight decrease for the third germination. The per cent abnormal cells for the three germinations showed an increase similar to that of the fragments per cell.

When the dosages of radiations were increased, there

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was a corresponding decrease in growth of seedlings from irradiated seeds.

Chlorophyll and morphological abnormalities were observed in the immediate generation as well as in the next generation. In the immediate generation out of 703 plants examined in the X-rayed group, 16 or 2.3 per cent had abnormalities, while in the thermal neutron group there were 84 or 14.1 per cent abnormal plants out of a total of 597 plants examined. Out of the total of 657 X_1 plants tested in the X_2 generation 26 or 4.0 per cent had some type of chlorophyll mutation. In the thermal neutron series 41 or 10.0 per cent out of the total of 412 N_1 plants tested in the N_2 generation had one or more chlorophyll mutants.

The X-rayed group had 46 or 7.0 per cent morphological mutants out of a total of 657 X_1 plants tested in the X_2 generation. The thermal neutron group had 69 or 16.7 per cent morphological mutants out of a total of 412 N_1 plants tested in the N_2 generation.

Biological equivalent values were calculated for each criterion and were used to determine the relationship of the X-ray and thermal neutron dose ranges in obtaining the regression lines. Generally the dosage range of the X-ray regression lines for the different criteria was from one-third to one-half that of the thermal neutron regression line range.

Thermal neutron radiation was less damaging to the tomato plants and gave a greater number of genetical changes than did the X-rays. 68 pages. $1.00. Mic 56-1638

BOTANY

A TAXONOMICAL-ECOLOGICAL STUDY OF THE VEGETATION BY HABITATS IN EIGHT FOREST TYPES OF THE OLYMPIC RAIN FOREST, OLYMPIC NATIONAL PARK, WASHINGTON

(Publication No. 16,541)

Grant William Sharpe, Ph.D.
University of Washington, 1956

Every American national park preserves some fundamental feature which distinguishes it from other national parks. Olympic National Park includes within its boundaries a rugged wilderness of mountains, glaciers, seascapes, and an abundance of wildlife, yet individually all of these features are found in other national parks. Olympic's unique feature is its westside forest—a rain forest. A mild climate, a gentle topography, and centuries of abundant rainfall—the highest in the United States—combine to make this forest unique.

In these ocean-facing valleys of the park, where the annual rainfall varies from 130 to 160 inches, the four major coniferous species of the Pacific Northwest attain their maximum sizes. The striking feature of these wet forests, in addition to the tree sizes, is the luxuriantly developed epiphytic vegetation found upholstering the trunks and crowns of all trees.

The study is introduced by a brief history of Olympic National Park and the reasons for this investigation. The description of the area of study includes climatic relations. geology, topography and drainage, soils, and general plant life conditions. Under plant life conditions is included a description of the forests; the epiphytic communities; the unusual manner in which conifer reproduction begins on rotting logs and develops into huge, straightlined colonnades; the buttress bases of Picea sitchensis; and the habitat of sphagnum moss, elsewhere found in ponds, but in the Olympic Rain Forest, growing on soil and over rotting logs. This section on plant life conditions also includes a study of plant-animal relations, largely the effect of the Roosevelt elk on the vegetation. As an estimated 2600 of these animals winter in the rain forest valleys, they undoubtedly alter plant succession.

The intensive collecting of the study revealed several species of plants not before reported for the State of Washington. These include: Pohlia vexans (moss), Scapania granulifera (liverwort), and two crustose lichens, Lecidea gelatinosa and Trimmatothele umbellulariae. The only reported Washington collection of Schistostega pennata, before the author found it in the rain forest, was in Mount Rainier National Park in 1899. The study also revealed three additional rare bryophytes, and eighteen rare lichens.

The work of this study took place over a four year period and is the first comprehensive study of the Olympic Rain Forest vegetation. To determine which plants, both phanerogams and cryptogams, occur in the rain forest, 176 ten thousand square foot plots were established in eight pure forest types. Within each plot all vegetation was recorded according to its abundance and sociability in six major habitats; the tree crown, tree trunk, tree base, rotting log, soil, and disturbed soil habitat. Four less common habitats, rock, seep, water, and bear scat were also considered.

All plots were located in mature stands on the valley floors at elevations not exceeding 1000 feet. The length of each of the four rain forest valleys of this study, below 1000 feet and still within the boundaries of the undisturbed park forests, averaged 14 miles. The plots recorded were distributed as evenly as possible over this entire area of study.

The writer, laden with about 75 pounds of instruments, plot sheets, camera equipment, sleeping gear, water repellent clothing, and food sufficient for a week to 10-day stay, back-packed alone on the many trips into the rain forest valleys. Each plot required from two to four hours to establish. Much time was saved by means of an elaborately devised four-page plot sheet form, upon which were listed the most common of the approximately 300 plant species encountered, with space provided for the less common species.

By means of synthesis tables a determination was made of the constancy class of each plant species by habitat occurrence within pure forest types. This constancy information is recorded on species-habitat sheets where it is represented by fraction, class, and graphically, by percent.

The thesis, containing 313 pages, includes precipitation and temperature charts, soil analysis tables, epiphyte charts for two newly fallen conifers, and 66 photographs.
335 pages. $4.19. Mic 56-1639

CHEMISTRY, GENERAL

THE KINETICS OF POLYMERIZATION AND CHAIN TRANSFER OF MONO AND DIALLYL COMPOUNDS

(Publication No. 12,344)

Arnold Adicoff, Ph.D.
Polytechnic Institute of Brooklyn, 1955

Supervisor: Dr. F. R. Eirich

The temperature dependence of the chain transfer constants and the reactivity ratios were determined for styrene with the following allyl compounds: allyl acetate, diallyl carbonate, diethylene glycol bis allyl carbonate, and allyl trimethyl acetate. Values for r_1 (M_1 = allyl compound) agree closely with previously determined results, i.e., r_1 0.01. Values of r_2 (M_2 = styrene) are of the order of 6 to 10 which are nine to ten times smaller than results of previous investigators, indicating that styrene tends to add to allyl compounds much more than had previously been thought. The differences are ascribed to the mode of polymer analysis.

Values for $E_{tr} - E_{21}$ were determined as .2 ± .3 kilocalories, where E_{tr} is the activation energy for radical 2 to transfer with monomer 1, and E_{21} is the activation energy required for radical 2 to add to the double bond of monomer. A value of -2.7 kilocalories was obtained for allyl trimethyl acetate and styrene indicating the probability of a radical displacement type of chain transfer mechanism, as suggested for this compound by Gaylord and Eirich.

The dependence of the rate of polymerization of allyl acetate was determined to be exactly first order with respect to catalyst and approximately first order with respect to monomer. A mechanism for these kinetics is suggested.

It is estimated that there is little hope of obtaining an allyl carbonate resin which is both heat resistant and shock resistant. The greatest improvement in allyl resins, however, is to be sought in the higher rather than in the lower temperature polymerizations.

Suggestions as to the nature of a polymer which is both heat and shock resistant are made on the basis of an analysis of the results. 168 pages. $2.10. Mic 56-1640

KINETIC STUDIES ON DIBORANE: I. THE REACTION OF DIBORANE WITH PHOSPHINE. II. PRELIMINARY INVESTIGATION OF RELATIVE RATES OF REACTION OF AMINES WITH DIBORANE, AND OF BORON TRIFLUORIDE AND DIBORANE WITH MONOMETHYLAMINE

(Publication No. 12,497)

Harry Brumberger, Ph.D.
Polytechnic Institute of Brooklyn, 1955

The research presented in this dissertation consisted of a kinetic study of the gas-phase reaction of diborane with phosphine to give the solid, BH_3PH_3, and of a preliminary investigation of the competitive reactions of amines with diborane, and of boron trifluoride and diborane with monomethylamine.

The course of the diborane-phosphine reaction was followed by pressure measurements. The kinetics of the reaction were unusual in that the rate of zero until a critical pressure of either reactant was exceeded, and then changed linearly with initial pressures of each material. This behavior is due to the reverse reaction, dissociation of the solid product. When either reactant is in excess, the rate-time data obey a pseudo-first-order equation, the rate at any time being proportional to the difference between the pressure at that time and the equilibrium pressure. The rates of formation and dissociation of solid BH_3PH_3 are independent of the amount of solid surface; the rate of formation is independent of wall surface.

These facts are consistent with a rate-controlling reaction of diborane and phosphine to give BH_3PH_3 and BH_3, the borine reacting further with phosphine, and the BH_3PH_3 condensing rapidly to the solid. An apparent activation energy of 11.4 ‡ 2.0 kcal/mole was obtained.

Results of the competitive rate studies indicate that trimethylamine reacts roughly twice as fast as ammonia with diborane, and about 1.3 times as fast as monomethylamine. Neither of these ratios is affected by pressure changes or the presence of large amounts of inert gas. Boron trifluoride was found to react about three times as fast as diborane with monomethylamine at pressures of the order of 100 to 500 mm, and roughly seven times as fast at reactant pressures of 6-7 mm, whether inert gas was present at these low-pressure runs or not.

133 pages. $1.66. Mic 56-1641

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

AMINO SUBSTITUTED POLYSTYRENES

(Publication No. 12,347)

Catherine S. Hsia Chen, Ph.D.
Polytechnic Institute of Brooklyn, 1955

Several new ion-exchange resins based upon nitropolystyrene, linear and crosslinked, were prepared and characterized. Upon reduction of nitropolystyrene, aminopolystyrene, linear and crosslinked, was obtained at about 85% conversion. Some of the physical and chemical properties of aminopolystyrene were investigated.

Quaternization of aminopolystyrene with methyl iodide resulted in the formation of a new strong base anion exchange resin. Comparative studies were made with this and similar commercial resins as regards their basities and exchange properties.

Sulfonation of aminopolystyrene (crosslinked) was studied extensively. By sulfonation of aminopolystyrene (crosslinked) and subsequent treatment with chloroacetic acid in alkaline medium, a new chelate ion-exchange resin of the anilinediacetic acid-o-sulfonic acid type was obtained. It was found to be a strong complex former toward certain metal ions as expected.

Upon diazotization followed by hydrolysis of aminopolystyrene (crosslinked), hydroxypolystyrene was obtained. When hydroxypolystyrene was subjected to a Mannich reaction using iminodiacetic acid as the Mannich base, another chelate ion-exchange resin of the o-hydroxybenzyliminodiacetic acid type was prepared. This resin was also shown to be a strong complex former with certain metal ions.

Several other resins were synthesized from crosslinked chloromethylated polystyrene: A chelate ion-exchange resin of the benzyliminodiacetic acid type was obtained by treatment of chloromethylated polystyrene with iminodiacetonitrile in a swelling agent followed by hydrolysis. When chloromethylated polystyrene was reacted with monoactylethylenediamine followed by cleavage of the acetyl group, a resin of the substituted ethylenediamine type was obtained. This resin, when treated with chloroacetic acid in alkaline media was converted to another chelate ion-exchange resin of the ethylenediamine tetracetic acid type. Quaternization of chloromethylated polystyrene with dimethyldodecylamine resulted in the formation of a resin of the Zephiran type and by treatment of chloromethylated polystyrene with dimethylamine a weak base anion exchange resin (tertiary amine type) was obtained. 151 pages. $1.89. Mic 56-1642

CRITICAL PHENOMENA IN AQUEOUS SOLUTIONS OF LONG-CHAIN QUATERNARY AMMONIUM SALTS

(Publication No. 12,499)

Irving Cohen, Ph.D.
Polytechnic Institute of Brooklyn, 1955

Solutions of Hyamine 1622 (di-isobutyl phenoxy ethocy ethyl dimethyl benzyl ammonium chloride) at concentrations above the critical micelle concentration have been studied as a function of NaCl concentration and temperature. At a fixed temperature there is a critical NaCl concentration above which the system separates into two layers; the top layer is practically free of the quaternary ammonium salt and the bottom layer shows the characteristics of an oil. The volume of the bottom layer decreases with increasing NaCl concentration. Before the onset of two-phase formation, the turbidity and the dissymmetry of light scattering increases with increasing NaCl concentration. Small temperature changes produce a marked change in the stability of the bottom layer. A reduction of the temperature of the system produces an effect which is analogous to an increase in electrolyte. For a fixed electrolyte concentration, there exists a critical temperature below which the system separates into two layers. In the immediate neighborhood of the critical electrolyte concentration or the critical temperature, the system exhibits a marked opalescence. These systems are relatively insensitive to cations. For mono-valent anions the relative effectiveness in inducing two-phase formation follows a lyotropic series.

The experimental results can be explained in terms of current concepts of critical solution phenomena where the electrolyte alters the interactions between the micelles of the quaternary ammonium salt. The details of these interactions are given qualitatively by the theory of Verwey and Overbeek. 85 pages. $1.06. Mic 56-1643

COMPETITIVE RATE STUDIES ON SOME VERY RAPID GAS PHASE REACTIONS

(Publication No. 12,500)

Jerome Daen, Ph.D.
Polytechnic Institute of Brooklyn, 1955

In the past a great deal of interest has centered on unimolecular decompositions and bimolecular associations. Though a great number of systems have been investigated, only a small number have been demonstrated to be true illustrations of these processes. To date, most studies have been made on totally organic systems. A recent and significant study of bimolecular association reactions has been the investigation of the reaction of boron trifluoride with the methylamines and ammonia. The results obtained on this system were, however, ambiguous due to the experimental technique.

Because of the great theoretical interest in these reactions, another method for determining the relative rates of rapid bimolecular gas phase reactions over a relatively wide pressure range was developed in this research. The apparatus, which permits work in the range 10^{-3} - 10^{-1} mm Hg, is a flow system in which a steady state is established with two or more reactants competing with each other for a deficiency of another reagent. A measurement of the influx rate and efflux rate of each of the competitors allows the estimation of the relative reactivities.

Using this apparatus, the relative reactivities of the methylamines with boron trifluoride were determined over the pressure range 10^{-3} - 10^{-1} mm Hg. Within the experimental error these were found to be pressure independent in this range and approximately

$$k_{mma}:k_{dma}:k_{tma} = 1:3:8.$$

For these studies an analytical method for the methylamines, based on infrared spectroscopy, was devised and the sorption of boron trifluoride on various surfaces, including Pyrex and polythene, was investigated.

During the development of the method, the importance of several variables was studied. Among these were the selectivity of a two-stage mercury diffusion pump towards various gases, the effect of various geometric arrangements on measured relative rates of reaction and the dependence of the measurements on composition and degree of conversion.

These studies have led to the development of an apparatus which permits the determination of the relative rate constants of rapid bimolecular reactions with a fair degree of precision. Such data will prove useful in testing current theory on bimolecular association and unimolecular dissociation reactions. 145 pages. $1.81. Mic 56-1644

DIFFUSION STUDIES IN POLYELECTROLYTE SOLUTIONS AND RADIOCOLLOIDS

(Publication No. 12,502)

James P. Dux, Ph.D.
Polytechnic Institute of Brooklyn, 1955

Among the unique applications of radiochemistry to the solution of physico-chemical problems is the use of radioisotopes to measure self-diffusion coefficients and tracer diffusion coefficients. The first type of measurement is concerned with the diffusion of isotopically "tagged" ions into solutions of the same concentration, but untagged; while tracer diffusion coefficient measurements are those determined when the concentration of diffusing substances is negligibly small compared to the concentration of other substances in the solution.

In this work these two types of diffusion coefficients were employed to investigate solutions of polyelectrolytes and radiocolloids, in particular the problem of the distribution of the counterions of polyelectrolytes between the bound and free states. The polyelectrolyte used was polystyrene sulfonic acid and the self-diffusion coefficient of strontium as counterion was studied with relation to the degree of neutralization of the acid and molecular weight of the polyion. It was found that the diffusion coefficient did not vary strongly with the neutralization of the acid when compared with results reported in the literature for the weak polyelectrolyte polyacrylic acid. The diffusion coefficient was constant over the range of neutralization for the low molecular weight (1230) polymer and decreased about 40% for the high molecular weight (32,500) material. A theoretical study of the relation between the observed diffusion coefficient and the coefficients of the free and bound counterions is presented and used to interpret these results.

Tracer diffusion coefficients of strontium were also determined in solutions of polystyrene sulfonic acid. These coefficients, in contrast to the self-diffusion coefficients, were found to be strongly dependent on the time of diffusion. This is interpreted as indicating that the few strontium ions present in these solutions are irreversibly bound to the polyions and the radioactive material is reflecting the motion of the polyions themselves.

Self-diffusion coefficients of the polyions themselves were also studied, using S^{35} tagged polystyrene sulfonic acid. These coefficients were determined simultaneously with tracer diffusion coefficients of strontium and the results serve to bear out the hypothesis of strong binding of the strontium under the conditions of tracer diffusion coefficient measurements.

Finally, the results of an investigation into the radiocolloidal properties of barium sulfate are presented. Electrophoresis experiments were run, which indicated that in the presence of sulfate ion the mobility of barium in low concentrations was essentially negligible. Diffusion coefficient measurements indicated that in the presence of sulfate ion, low concentrations of barium were in an unstable or metastable state since it was found that the diffusion coefficient was highly unreproducible and tended to decrease with time of standing of the solution.

182 pages. $2.28. Mic 56-1645

THE ATTEMPTED RESOLUTION OF 3,4-EPOXY-1-BUTENE AND THE REACTION OF 3,4-EPOXY-1-BUTENE WITH PHENYLMAGNESIUM BROMIDE AND DIPHENYLMAGNESIUM

(Publication No. 12,350)

Harvey Gurien, Ph.D.
Polytechnic Institute of Brooklyn, 1955

Part I

Attempted Synthesis of Optically Active 3,4-Epoxy-1-butene

In elucidating the mechanism of the reaction of Grignard reagents with 3,4-epoxy-1-butene it was necessary to have the optically active oxirane derivative. Isolation of a racemic alcohol after reaction would be indicative of an S_N1 type reaction while isolation of an optically active product would indicate an S_N2 type.

Attempts to prepare optically active 3,4-epoxy-1-butene were made by (1) the recrystallization of the strychnine salt of 4-chloro-1-buten-3-yl hydrogen phthalate, (2) the recrystallization of 2-hydroxybut-3-en-1-yl trimethylammonium hydrogen d-tartrate, and (3) the recrystallization of 4-dimethylamino-3-hydroxy-1-butene salts of d-camphor sulphonic acid and dibenzoyl d-tartaric acid. None of these systems proved capable of providing the optically active intermediate required for conversion to optically active 3,4-epoxy-1-butene.

Part II

The Reaction of 3,4-Epoxy-1-butene with Phenylmagnesium Bromide and Diphenylmagnesium

The oxirane ring has been known to react with organometallic compounds for fifty years. Factors which have been studied are those causing rearrangement of the ring during reaction, steric factors as they influence the course of ring opening and the comparison of Grignard reagents, organomagnesium and organolithium compounds. The influence of unsaturated substituents, however, has not been extensively investigated. It was the purpose of this part of the investigation to determine the course of reaction of phenylmagnesium bromide and diphenylmagnesium with

3,4-epoxy-1-butene, and to study the effect of added ferric chloride.

Phenylmagnesium bromide gave with 3,4-epoxy-1-butene a 90% yield of 2-phenyl-3-buten-1-ol. In the presence of added ferric chloride the yield of the same product was reduced to 27%. No additional product could be isolated from the product mixture.

With diphenylmagnesium, a pure alcohol could not be isolated, nor adequately characterized via derivatives, probably due to its facile dehydration.

The high yield of 2-phenyl-3-buten-1-ol from phenylmagnesium bromide as compared with the mixture formed in reaction of Grignard reagents with 1,2-epoxypropane suggests an interaction between the vinyl group and the oxirane ring. This interaction can be viewed as being emphasized by co-ordination of the oxirane ring with magnesium, increasing the importance of structures such as $CH = CH_2 - CH - CH_2$, to the transition state.

$$\overset{\oplus}{} \quad O^{\ominus}$$

Ferric chloride, as expected, decreases the yield of the expected alcohol, possibly by promotion of a more non-specific radical reaction.

Such interaction of a conjugated double bond with the oxirane ring is supported by similar reactions with other Grignard reagents, and by the infrared absorption spectrum, which shows an abnormal band for the oxirane ring.

98 pages. $1.23. Mic 56-1646

COPRECIPITATION OF THE TRANSURANIUM ELEMENTS WITH THE RARE EARTHS. COPRECIPITATION OF AMERICIUM WITH LANTHANUM OXALATE.

(Publication No. 16,649)

John Alexander Hermann, Ph.D.
The University of New Mexico, 1956

The coprecipitation of americium with lanthanum oxalate hendecahydrate is investigated. The separation and purification of americium from lanthanum and other cationic impurities by fractional precipitation of lanthanum oxalate is demonstrated. Fractions of the lanthanum oxalate carrier were precipitated from homogeneous solutions by the hydrolysis of dimethyl oxalate in dilute nitric acid solutions. Americium is enriched in the precipitate in accordance with the heterogeneous distribution law of Doerner and Hoskins up to a composition of at least 14 mole % americium in the precipitate. Americium was separated from all other cationic impurities detected to a degree equal to or greater than the separation from lanthanum. The impurities detected included bismuth, iron, chromium, aluminum, lead, manganese, magnesium, calcium, strontium and barium.

The extent of coprecipitation of americium is shown to vary with the rate of precipitation of lanthanum oxalate, decreasing as the rate of precipitation increases. A theory for the effect of rate of precipitation on coprecipitation is presented, based on the qualitative relationship between rate of precipitation and supersaturation. An equation relating the observed distribution coefficient with the supersaturation, and thus indirectly with the rate of precipitation, is derived. The application of the supersaturation concept to published data on coprecipitation and to occlusion of impurities by analytical precipitates is discussed. It is suggested that many carrying phenomena of ionic precipitates which have been explained qualitatively by occlusion can be explained quantitatively by relating coprecipitation to supersaturation.

A new method of measuring the heterogeneous distribution coefficient is presented. The method depends upon achieving experimental conditions so that the carrier precipitate is brought down from a saturated solution of constant carrier concentration. Under these conditions the heterogeneous distribution coefficient, $\underline{\lambda}$, is determined experimentally in accordance with the equation

$$\log_e \frac{\text{Total tracer}}{\text{Tracer left in solution}} = \lambda \frac{\text{Weight of carrier precipitated}}{\text{Weight of carrier in solution}}.$$

For the americium-lanthanum oxalate coprecipitation system the distribution coefficient, $\underline{\lambda}$, was found to be $6.5 \pm .1$. The method has possible industrial application in the field of radioactive waste decontamination. A high "carrying" efficiency requires not that the distribution coefficient be high but that the ratio of the distribution coefficient to the carrier solubility be high.

124 pages. $1.55. Mic 56-1647

STEROL MODELS, 9-METHYLDECALINS

(Publication No. 12,504)

Martin Idelson, Ph.D.
Polytechnic Institute of Brooklyn, 1955

To locate the infrared absorption band characteristic of angular methyl groups in sterols, 9-methyl-cis- and trans-decalins were chosen as model compounds and prepared by stereospecific syntheses; analogous deuteromethyl compounds were also prepared to determine whether the suspected absorption at 1380 k would disappear.

9-Methyl-cis-decalin could have been prepared by any of many known reaction sequences, but they were not used because of some ambiguity or because of poor yield, which was important for preparing the deuterated compounds. Therefore, a new snythesis was devised utilizing the stereospecific Diels-Alder reaction. A number of substituted cyclohexenes were made and heated with butadiene to a temperature of 200° in the hope of obtaining the 9-substituted cis-2-octalones. The substituents were chosen so that they could eventually be reduced to a methyl or deuteromethyl group. Unfortunately, the Diels-Alder reaction failed in every case.

The catalytic hydrogenation of several Δ^4-3-octalones has been reported to produce the cis-decalin structure. Accordingly, ethyl Δ^4-3-octalone-9-carboxylate was catalytically reduced, and the ketone function was reduced by the Clemmensen method to produce ethyl decalin-9-carboxylate. Lithium aluminum hydride reduced the ester to 9-hydroxymethyldecalin, the tosylate of which could not be reduced in good yield with lithium aluminum hydride. However, the tosylate could be reduced to 9-methyldecalin by treatment with sodium benzylmercaptide followed by Raney nickel hydrogenolysis.

The 9-methyldecalin so produced agreed in its physical constants with both Linstead's and Hussey's

9-methyl-cis-decalin. The latter had prepared it by essentially the same route as in the present work. The nature of the problem required that there be no doubt about the structure of the model compounds. On this premise, Linstead's synthesis was repeated. The physical constants again agreed, but the infrared spectra of the two compounds were different.

Careful examination of the literature revealed that Linstead's compound was authentic 9-methyl-cis-decalin. The structure proof rests on the stereospecificity of the Diels-Alder reaction and on the structure of the sterols, themselves. The work of Linstead, Robinson and Woodward is intertwined in a network of unambiguous facts, and there can be no reasonable doubt about the structure of Linstead's hydrocarbon.

By the method of synthesis, Hussey's compound must be 9-methyl-trans-decalin. But Linstead claimed that aluminum chloride-catalyzed isomerization of his cis isomer gave the trans isomer. The authentic trans isomer does not even closely resemble Linstead's trans isomer, which probably is 1-methyl-trans-decalin. 9-Methyl-trans-decalin, under the same conditions, also isomerizes to Linstead's isomerization product, but much more slowly.

Starting with ethyl trans-decalin-9-carboxylate and using deuterated reagents, 9-methyl-d_3-trans-decalin was prepared.

Because of the low yield, Linstead's route could not be used for 9-methyl-d_3-cis-decalin. Instead, ethyl Δ^4-3-octalone-9-carboxylate was converted first to 3-ethylenedioxy- Δ^4-octalin-9-carboxylate and then reduced with lithium aluminum hydride to 3-ethylenedioxy-9-hydroxymethyl- Δ^4-octalin. Catalytic hydrogenation and Clemmensen reduction gave 9-hydroxymethyl-cis-decalin, which was converted to 9-methyl-cis-decalin by the same procedure as for the trans isomer. The substitution of lithium aluminum deuteride gave 9-methyl-d_2-cis-decalin.

With ordinary and deuterated compounds at hand, the infrared spectra were measured. The symmetric methyl bending frequency was proved to occur at 1380 k in both 9-methyl-cis- and trans-decalins by the disappearance of that band in the deuterated compounds. Similar results were obtained with 3a-methyl-cis- and trans-hydrindans and their deuterated analogues; these compounds were supplied by R. L. Kronenthal.

94 pages. $1.18. Mic 56-1648

THE 3a-METHYLHEXAHYDROINDANS

(Publication No. 12,508)

Richard L. Kronenthal, Ph.D.
Polytechnic Institute of Brooklyn, 1955

The definite assignment of the infrared absorption frequencies of the C-18 methyl group in sterols was the problem existing at the outset of this work. As a means towards its solution, the stereoisomeric 3a-methylhydrindans, along with the corresponding deuteromethyl analogues, were to be obtained by unequivocal synthesis. Through a Diels-Alder synthesis, a methoxycarbonyl group was locked into the cis configuration at the angular position of a tetrahydroindan and transformed, via the saturated angular ester, hydroxymethyl and corresponding tosylate of the latter, to the desired 3a-methyl-cis-hexahydroindan. By employing the appropriate combinations of lithium aluminum hydride and lithium aluminum deuteride, the cis-mono-, di-, and trideuteromethyl-cis-hexahydroindans were also obtained.

3a-Methyl-trans-hexahydroindan was attained through 4a-ethoxycarbonyl-trans-3, 4, 4a, 5, 6, 7, 8, 8a-octahydro-2- [1H] - naphthalenone. After the oxo group was converted to the corresponding dioxolane, the angular ester was reduced to the hydroxymethyl group and then to the angular methyl group through the tosylate and benzyl thioether. After hydrolysis of the dioxolane, the resulting methyldecalone was oxidatively cleaved, recyclized to the corresponding hydrindanone and finally reduced to 3a-methyl-trans-hexahydroindan. By starting with the dioxolane ester and using lithium aluminum deuteride and deuterated Raney nickel, the corresponding deuterium containing analogues were obtained.

99 pages. $1.24. Mic 56-1649

THE SYNTHESIS AND DECOMPOSITION OF LARGE MEMBERED RING AZO COMPOUNDS

(Publication No. 12,510)

Milton Lapkin, Ph.D.
Polytechnic Institute of Brooklyn, 1955

Convenient sources of biradicals were desired in order to study the properties of moderately active biradicals in solution and to test theoretical predictions that biradical propagation in free radical catalyzed vinyl polymerization was unlikely. The main effort was then directed towards the synthesis and characterization of large membered ring azo compounds.

Tetraphenyl-1,2,13,14-tetraaza-2,12,14,24-cyclotetracosatetraene, a 24 membered cyclic azine, and the 28 membered homologue were prepared and characterized. These were converted to the corresponding azo compounds, 3,12,15,24-tetraphenyl-1,2,13,14-tetraaza-1,13-cyclotetracosatetradiene, a 24 membered ring, and the 28 membered homologue.

The rates of decomposition of the 24 membered cyclic azo compound at 111^0 (8.9×10^{-5} sec.$^{-1}$) and 120^0 (2.2×10^{-4} sec.$^{-1}$) were determined and found to be only slightly larger than that previously found for a linear azo compound, propiophenone azo (7.2×10^{-5} sec.$^{-1}$) (110^0). The calculated activation energy of the cyclic azo compound (30.2 kcal./mole) was slightly lower than the activation energy of the linear azo compound (32.3 kcal./mole).

A 22 membered cyclic azo compound was proposed as an intermediate in the above decomposition. A mathematical treatment was outlined for the calculation of the rates of decomposition of the two independent azo linkages in the 24 membered azo compound. It was suggested that the rate of decomposition of the primary azo linkage was about twice as fast as the azo linkage in the postulated 22 membered cyclic intermediate.

The decomposition products of the 24 membered cyclic azo compound in xylene were examined. A product was isolated in 72% yield which was identified as the 1,2,11,12-tetraphenylcycloeicosane, a 20 membered cyclic hydrocarbon.

The decomposition of the 24 membered cyclic azo compound in styrene was examined. Initiation by the cyclic catalyst was found to be extremely inefficient for the propagation of a growing polymer chain. The lack of reactivity of the cyclic azo initiator is discussed in terms of proposed theory. It seems clear that normal biradical propagation is unlikely even with these favorable circumstances. 90 pages. $1.13. Mic 56-1650

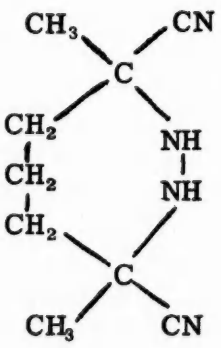
PART I: PREPARATION AND OXIDATION OF 1,1-DISUBSTITUTED HYDRAZINES
PART II: CYCLIC AZO COMPOUNDS

(Publication No. 12,511)

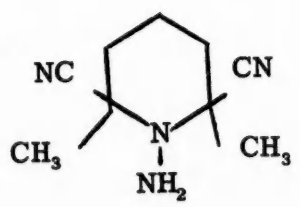
Burton S. Marks, Ph.D.
Polytechnic Institute of Brooklyn, 1955

The results of Part I of this dissertation are described in three sections.

In Section I, the reaction between heptane-2,6-dione, hydrazine sulfate, and sodium cyanide has been reexamined. It has been shown that the product is II, 1-amino-2, 6-dimethylpiperidine instead, of I, 3,7-dimethylhomopiperidazine, previously reported.



I



II

Section II describes a convenient synthesis of some 1, 1-disubstituted hydrazines. In particular, 1-amino-2,6-dimethylpiperidine and 1,1-dibenzylhydrazine were prepared by nitrosation of the corresponding secondary amines followed by reduction with lithium aluminum hydride in high yield. A few novel reduction procedures with the use of 5% rhodium on alumina catalyst are reported.

In Section III, the oxidation of 1,1-dibenzylhydrazine with bromine in ethanol and with tert-butylhypochlorite followed by base has been studied. Two reaction paths are proposed, one to form bibenzyl by an unusual nitrogen elimination and two, the formation of a tetrazene and its decomposition products, benzylamine, dibenzylamine and benzaldehyde. In the bromine oxidation, ethyl benzoate was also isolated. In the latter oxidation, some tribenzylhydrazine and stilbene were also found. The oxidation of 1-amino-2, 6-dicyano-2, 6-dimethylpiperidine with permanganate was examined and the products compared with the previously reported bromine oxidation of the same compound. It is concluded that resonance stabilization of the intermediate after loss of nitrogen favors the abnormal reaction, that is, nitrogen elimination without tetrazene formation. 90 pages. $1.13. Mic 56-1651

THE HEAT CAPACITY AND MAGNETIC SUSCEPTIBILITY OF VANADIUM AMMONIUM ALUM FROM 1.15°K TO 20°K

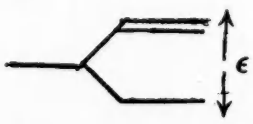
(Publication No. 16,726)

Harry L. Pinch, Ph.D.
The Pennsylvania State University, 1956

The magnetic susceptibility of vanadium ammonium alum, $VNH_4(SO_4)_2 \cdot 12\,H_2O$, was measured over a temperature range of 300° K by Van Den Handel and Siegert in 1937.[1] Their results substantiated to a high degree Siegert's[2] previous work on the quenching of the orbital contribution to the susceptibility in the alums. However, their data in the liquid helium range are rather sparse and their characterization of the lowest spin multiplet was only approximate. The present study undertook to characterize fully the lowest lying level in vanadium alum through the measurement of the heat capacity and also to extend the magnetic susceptibility measurements at low temperatures.

An apparatus was built, modelled after that used by Fritz and Giauque in their investigation of cobalt sulfate heptahydrate.[3] A glass bulb, ellipsoidal in shape, served as the sample container and calorimeter. A carbon thermometer-heater was painted on the sample bulb and the sample bulb was mounted inside a glass vacuum jacket. Calorimetric measurements were made by supplying electrical energy directly to the carbon thermometer-heater. A series of coils, known as the fluxmeter, was placed on the outside of the calorimetric vacuum jacket and was used for the measurement of the susceptibility.[4]

The heat capacity was measured from 1.8°K to 20°K. A typical Schottky anomaly was exhibited with a maximum value of 1.5 cal/mol-deg occurring at about 2.7°K. From their susceptibility measurements, Van Den Handel and Siegert deduced the splitting pattern for the lowest spin triplet to be as follows:



and they estimated that ϵ was about 5 cm^{-1} or 14.3 cal/mol. For the splitting pattern as shown the partition function can be written as $Z = 1 + 2e^{-\epsilon/RT}$. The magnetic heat capacity is calculated from the expression

$$C = R\left(\frac{\epsilon}{RT}\right)^2 \frac{2e^{-\epsilon/RT}}{(1 + 2e^{-\epsilon/RT})^2}$$

The use of the value 13.7 ± 0.1 cal/mol for ϵ resulted in an excellent agreement between the calculated magnetic heat capacity and the measured heat capacity. The measurements thus verify the splitting pattern and the energy of separation obtained compares very well with that given by Van Den Handel and Siegert.

The magnetic susceptibility measurements duplicate the data of Van Den Handel and Siegert. However the recent data exhibits a lower temperature independent susceptibility and follows a "spin-only" susceptibility more closely. The magnetic measurements represent a slight improvement over the previous measurements in that Siegert's theory of alums can be fitted to it more closely.

BIBLIOGRAPHY

1. J. Van Den Handel and A. Siegert, Physica 4, 871, (1937).
2. A. Siegert, Physica 4, 138, (1937).
3. J. J. Fritz and W. F. Giauque, J. Am. Chem. Soc., 71, 2168, (1949).
4. W. F. Giauque, J. J. Fritz, and D. N. Lyon, J. Am. Chem. Soc., 71, 1647, (1949).

VITA

Harry L. Pinch was born in Toronto, Canada in 1929. In 1935 he came to the United States, lived briefly in Bayonne, New Jersey, and settled in New York City. He attended the public schools of New York and in 1951 he received the Bachelor of Science degree cum laude from The City College of The College of The City of New York. He began his graduate study for the doctorate in February 1951 at The Pennsylvania State University and was awarded the Ph. D. in January 1956. His major field was physical chemistry, his minor field physics. In 1955 he married Miss Judith L. Emdin of Summit, New Jersey, who received her Master of Arts degree from The Pennsylvania State University.

55 pages. $1.00. Mic 56-1652

STUDIES OF THE DISULFIDE BOND

(Publication No. 12,517)

Norman A. Rosenthal, Ph.D.
Polytechnic Institute of Brooklyn, 1955

Supervisor: Gerald Oster

PART I

An Examination of Disulfide Ultraviolet Absorption Spectra as a Function of pH

The mechanism of the alkali cleavage of disulfides proposed by Schöberl is thought to involve a nucleophilic displacement by hydroxide or alkoxide on sulfur to yield a mercaptan and a sulfenic acid:

$$OH^- + RCH_2S\text{-}SCH_2R \longrightarrow RCH_2SOH + RCH_2S$$
$$\downarrow$$
$$H_2S + RCHO$$

The finding that reagents of comparable nucleophilicity to that of hydroxide or alkoxide fail to cleave suggested that the unique behavior of hydroxide and alkoxide in this respect is due to their base strength rather than their nucleophilicity. The possibility that an acid-base relationship might be operative here led to an extensive study of the ultraviolet spectra of a large number of disulfide compounds as a function of pH.

This study revealed that the disulfide linkage is characterized by a specific and a non-specific ultraviolet absorption. For compounds which possess a dissociable hydrogen which is attached to the carbon atom adjacent to the disulfide link (α- hydrogen) the ultraviolet spectra is observed to shift from the non-specific absorption at low pH to a specific absorption at higher pH values. A typical illustration of these facts is seen in the changes that occur in the ultraviolet absorption spectra of 1-cystine as a function of pH.

These ultraviolet spectral changes which result on alteration of the pH are reversible and are indicative of some type acid-base relationships involving the α-hydrogens. The effect of an increase in the pH is in essence to produce an ultraviolet chromophore. Compounds lacking α-hydrogens, such as the tertiary disulfides (t) butyl disulfide and penicillamine disulfide exhibit only a non-specific absorption which shows no alteration with pH. It is noteworthy, that these latter compounds are not cleaved by alkali.

For each of those disulfide compounds which possess dissociable α-hydrogens a critical pH appears to exist, below which only the non-specific absorption spectra is observed. At pH values greater than some critical pH specific absorption is noticed. In general an increase in pH above the critical pH causes an increase in the value of the extinction coefficient. In the case of 1-cystine the critical pH is in the neighborhood of 4.5, whereas the critical pH for dithiodiglycolic acid is around 12.5. At pH 12.5 dithiodiglycolic acid requires three days in order to achieve its maximum value of its extinction coefficient. The attainment of an absorption maximum with time is thought to correspond to the gradual ionization of α-hydrogens leading to chromophore production. The essential chromophore responsible for disulfide absorption is the

R -
-C=S- group

which only comes into being on dissociation of the acidic α-hydrogen. This chromophore is believed to correspond to an electronic distribution represented by a resonance form of the carbanion formed in alkali and involves the expansion of the sulfur octet. In all likelihood the ultraviolet chromophore has the form -X=S- where X=N or C. This is suggested by the fact that the ultraviolet spectrum of dithiodimorpholine in which the sulfur is bound to the N instead of the carbon >N=S-S=N< is also subject to changes in pH.

The isolation of glyoxylic acid from an alkali solution of dithiodiglycolic acid is regarded as an attack by alkali upon this disulfide compound via the following ionic mechanism:

$$OH^- \rightarrow HOOC\text{-}\underset{H}{\overset{H}{C}}\text{-}S\text{-}S\text{-}CH_2\text{-}R \longrightarrow HOOC\text{-}\overset{-}{C}\text{-}S\text{-}S\text{-}CH_2\text{-}R \quad (1)$$
$$\text{H}$$
$$HOOC\text{-}C\text{-}S\text{-}S\text{-}CH_2\text{-}R$$
$$\text{H}$$

(Chromophore)

$$HOOC\text{-}\overset{-}{C}\text{=}S\text{-}S\text{-}CH_2\text{-}R \xrightarrow{H_2O} HOOC\text{-}C\text{=}S + HS\text{-}CH_2\text{-}R \quad (2)$$
$$\text{H} \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \text{H}$$
$$\downarrow CH^-$$
$$HOOC\text{-}C\text{=}O + H_2S$$
$$\text{H}$$

The proposed mechanism is considered to be a modified β-elimination wherein the attack by base produces a carbanion beta to the bond between the two sulfur atoms. By means of a typical electronic arrangement the disulfide linkage is severed and a mercaptide and a readily hydrolyzable thiocarbonyl is produced. Kornblum et al. have shown that the unsymmetrical peroxide phenyl ethyl (t) butyl peroxide on treatment with alkali yielded phenyl ethyl ketone and (t) butyl alcohol. The mechanism for the alkali disulfide cleavage that we have proposed is identical with the β-elimination mechanism of Kornblum. The results of synthesis and alkali treatment of an analogous unsymmetrical disulfide of the type $R\text{-}\overset{R}{\underset{R}{C}}\text{-}S\text{-}S\text{-}\overset{H}{\underset{R}{C}}\text{-}R$ were inconclusive in establishing the validity of either our or Schöberl's mechanism. An approach to a definitive solution to this problem wherein the α-hydrogens of an aliphatic disulfide are replaced by deuterium is suggested.

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PART II

Kinetics of Mercaptan Disulfide Interchange as Observed in the Cystine-Cysteine System

The kinetics of mercaptan disulfide interchange in the cysteine-cystine system were studied polarimetrically by measuring the 1-cystine produced on reacting meso-cystine with 1-cysteine. The optical inactivity of meso-cystine and the very small specific rotation of 1-cysteine in sharp contrast to the large specific optical rotation of 1-cystine permit one to correlate the observed increase in optical rotation with time, with the formation of 1-cystine.

The method is unique in that it allows the study of the reaction of a mercaptan with its own disulfide, a fact which suggests that the process is in interchange and not an oxidation-reduction. The effects of varying such parameters as oxygen concentration, cysteine concentration, pH and temperature were investigated. The reaction was observed to have an activation energy of 7.5 K cal. and an equilibrium constant $K_{equil.} = 0.5$. The reaction was shown to follow first order kinetic plot in agreement with the results obtained by Bersin and Steudel in the cystine-thioglycolic acid system.

PART III

Microspectrophotometric Determination of Insulin, Glutathione and Cystine

The qualitative observation of Funatsu that phosphoric acid solutions of proteins containing cystine and serine on heating with diphenylamine and stannous chloride produce a blue green color, has been developed here into a quantitative microspectrophotometric method applicable to the determination of insulin, glutathione and cystine. The specific color developed which may be read at 356 mμ or 615 mμ is believed to arise as a result of a coupling reaction of diphenylamine with the mercaptan formed on reduction of the disulfide bond with stannous chloride.

Some of the anomalous properties associated with 1-cystine such as a high specific rotation, a very limited solubility and an abnormally large acidity are interpreted in terms of a postulated claw-like molecular structure for cystine. A comparison is made with a methyl substituted analog penicillamine disulfide. The anomalous optical rotation is believed to result from the combined effects of the two assymetric centers and the helical configuration of the molecule as a whole.

172 pages. $2.15. Mic 56-1653

STUDIES OF THE MAGNETIC PROPERTIES OF SEVERAL MIXED OXIDE SYSTEMS

(Publication No. 12,354)

Rubin Nathan Summergrad, Ph.D.
Polytechnic Institute of Brooklyn, 1955

Attempts were made to prepare two series of mixed oxides with perovskite structures. Series (A) has the general formula $LaM^{III}_{1-x}N^{III}_{x}O_3$, M and N being different trivalent transition elements. Ferromagnetic properties found in such systems could not be explained on the basis of Zener's theory, which requires the presence of one transition element in two valence states. The preparation of a second series of mixed oxides, series (B), ideal formula $La_{1-x}A^{II}_{x}M^{III}_{1-x}M^{IV}_{x}O_3$, where A is an alkaline earth element and M is a transition element in valence states III and IV, was attempted. This series would be analogous to Jonker and van Santen's compounds whose magnetic and electrical properties were explained by Zener.

Although several of the mixed oxides in series (A), containing iron, showed ferromagnetism this was not definitely attributed to the perovskite phase, since more than one phase was present. In series (B) the mixed oxides of cobalt were found to be ferromagnetic. Jonker and van Santen published a study of the mixed oxides, $La_{1-x}Sr_xCoO_3$, at this time. In this study they showed that the high strontium members of this series contain less oxygen than is shown by the idealized formula. The effect of firing the cobalt oxides under high oxygen pressure, in an effort to increase their oxygen content, was investigated. The higher oxygen content was expected to affect the magnetic properties. A special reaction vessel was built for these purposes. Although the iron oxides of series (B) also appeared to be ferromagnetic, this probably is due to small quantities of such compounds as $BaO{\cdot}6Fe_2O_3$. No other oxides in series (B) appeared to be ferromagnetic.

To determine whether the ferromagnetic properties of these oxides with iron could be attributed to a reaction product of lanthanum and iron oxides, a series of mixed oxides of lanthanum and iron was studied. It has recently been claimed that $LaFeO_3$ with a perovskite structure is weakly ferromagnetic. This claim contradicts that of previous workers. It was thought that this study might clarify this controversy as well. Ferromagnetism was noted in many of the samples but was later traced to impurities picked up in milling.

No clear solutions were obtained of the problems posed at the start of the investigation of series (A) and (B). Much of the difficulty encountered was due to the failure to obtain pure phases. This might be due to impurities picked up in milling as in the case of the La_2O_3-Fe_2O_3 system. The high oxygen pressure studies showed a definite increase in oxygen content in only one case, and in that case there was a change of structure.

A new series of ferromagnetic oxides with the general formula, $A_{\frac{1}{2}}La_{\frac{1}{2}}Fe_{12}O_{19}$, where A is an alkali metal gave a value of about 43 Bohr magnetons per unit cell, compared to 44 Bohr magnetons for $BaO{\cdot}6Fe_2O_3$. The anistropy constant at room temperature was 3×10^6 erg/cm^3, identical with that found for $BaO{\cdot}6Fe_2O_3$. The evidence demonstrates that these materials show ferromagnetic behavior of the same kind that is found in $BaO{\cdot}6Fe_2O_3$.

It seems likely that the ferromagnetism reported for $LaFeO_3$ might very well be due to the presence in small quantities of one of the alkali-lanthanum iron oxides discussed above. The Curie temperature of $LaFeO_3$ is reported in the literature to be 465° C, while the corrected Curie temperature of the new materials is about 440° C.

150 pages. $1.88. Mic 56-1654

THE DIELECTRIC CONSTANTS OF THE SYSTEMS: ETHYLENE CARBONATE-BENZENE, ETHYLENE CARBONATE-METHANOL, AND ETHYLENE CARBONATE-WATER

(Publication No. 16,734)

Ernest Charles Vieira, Ph.D.
The Pennsylvania State University, 1956

Solutions of electrolytes in solvents of high dielectric constant other than water should be studied since some of our generalizations may be based on behavior peculiar to aqueous solutions. It was thought that ethylene carbonate would have a high dielectric constant along with its other desirable properties. Therefore, an investigation was carried out to determine the electric moment of ethylene carbonate, its dielectric constant, and the dielectric constants of solutions of ethylene carbonate with benzene, methanol, and water.

The apparatus used for these measurements was a bridge circuit. The frequencies used ranged from 20000 to 40000 cycles per second. Two cells were employed in the measurements. One was made of nickel and had a capacitance of 64 $\mu\mu$f. This cell was calibrated with benzene and checked with solutions of acetonitrile in benzene. The other cell was made of brass and had a capacitance of 11.2 $\mu\mu$f. This smaller cell was calibrated with dioxane-water solutions and checked with methanol-water solutions.

The electric moment of ethylene carbonate was determined from measurements on solutions of ethylene carbonate in benzene ranging in concentration from .0009 to .04 mole fraction. The calculations were carried out by two methods. The electric moment obtained from these measurements and calculations was 4.87 Debye units.

The dielectric constants of the systems ethylene carbonate-benzene and ethylene carbonate-methanol were measured over the entire range of composition at 25° C. and 40° C. The dielectric constants of the system ethylene carbonate-water were measured at 25° C.

The first two systems make known solutions ranging in dielectric constant from 2 to 90. The measurements with water make known solutions passing to a non-aqueous medium without a great change in dielectric constant.

The variation of the dielectric constant of ethylene carbonate with temperature from 25° C. to 60° C. follows the equation: $D = D' - .408(t - t')$.

The infrared spectra of solid ethylene carbonate and of ethylene carbonate in CCl_4 were obtained.

58 pages. $1.00. Mic 56-1655

VITA

Ernest Charles Vieira was born in Lawrence, Massachusetts on March 3, 1927. He received his elementary education in the schools of Lawrence, Massachusetts and secondary education in New Bedford, Massachusetts. He served two years with the Armed Forces. He attended Northeastern University from 1947 to 1952 and received the B. S. degree in June 1952. He received his Ph.D. degree from The Pennsylvania State University in January 1956.

THE SOLVOLYSIS OF ESTER–ACID COPOLYMERS

(Publication No. 12,355)

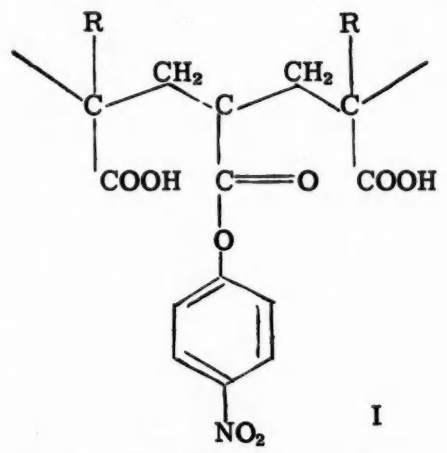
Paula Ethel Zimmering, Ph.D.
Polytechnic Institute of Brooklyn, 1955

In the solvolysis of copolymers of acrylic acid containing 2 to 9% p-nitrophenyl methacrylate, the anticipated electrostatic effect of the polyelectrolyte in influencing the local concentrations of the catalyzing acid or base is far outweighed by the ability of the neighboring carboxylate ion to function as a Lewis type base catalyst.

The intrinsic catalytic power of the carboxylate ion is exceedingly low compared to that of either hydroxyl ion or hydronium ion. It was therefore anticipated that the intense electrical forces operating in solutions of partially neutralized polyelectrolytes which produce variations in the local concentrations of counterions within the solution would result in marked difference in the rate of acid-base catalyzed reactions when these reactions are either confined to the surface of the polyion or are limited to occurring in the bulk of the solution. The magnitude of such an effect could be predicted quantitatively from the titration behavior of the polyelectrolyte.

The participation reaction, however, enhances the rate of solvolysis of the ester component by up to six orders of magnitude over that of p-nitrophenyl trimethylacetate in the intermediate pH range.

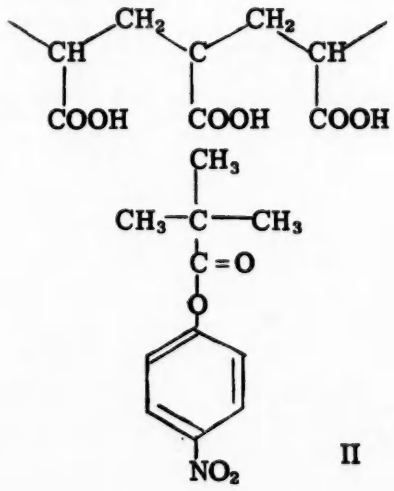
Copolymers of p-nitrophenyl methacrylate with acrylic acid (Ia) and with methacrylic acid (Ib) were prepared and the rate of solvolysis of the copolymers was followed by following the large shift in the absorption spectrum as



(a) R = H
(b) R = CH_3

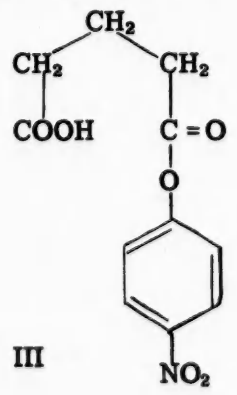
I

p-nitrophenol was liberated. These systems were compared with p-nitrophenyl trimethylacetate in the presence of polyacrylic acid (II)



II

and with the mono-p-nitrophenyl glutarate (III).



III

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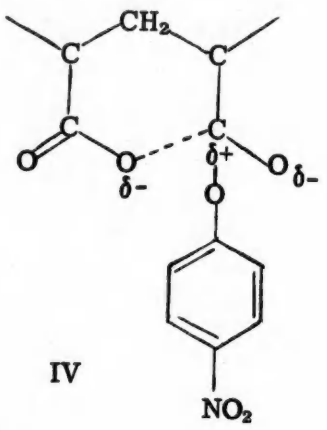
The participation reaction proceeds through the formation of a six-membered intermediate (IV).



IV

Fig. 1 gives the pH dependence of the hydrolysis rate of the copolymer and the trimethylacetate.

A change in the polarity of the solvent affects the reaction rate of the copolymer chiefly through the change in the degree of ionization. When the degree of ionization is fixed, other solvent effects similar to those in simple esters are observed.

In the intermediate pH range, hydrolysis of mono-p-nitrophenyl glutarate shows a similar behavior to that of the copolymers and to that of acetylsalicylic acid. The energies of activation of these two systems are the same showing that the two systems are reacting by the same mechanism. The entropies of activation seem to indicate a less favorable steric factor for the mono-glutarate and suggests that the more rigid structure of the copolymer chain on the average holds the carboxyl group and the ester group in a more favorable position for reaction.

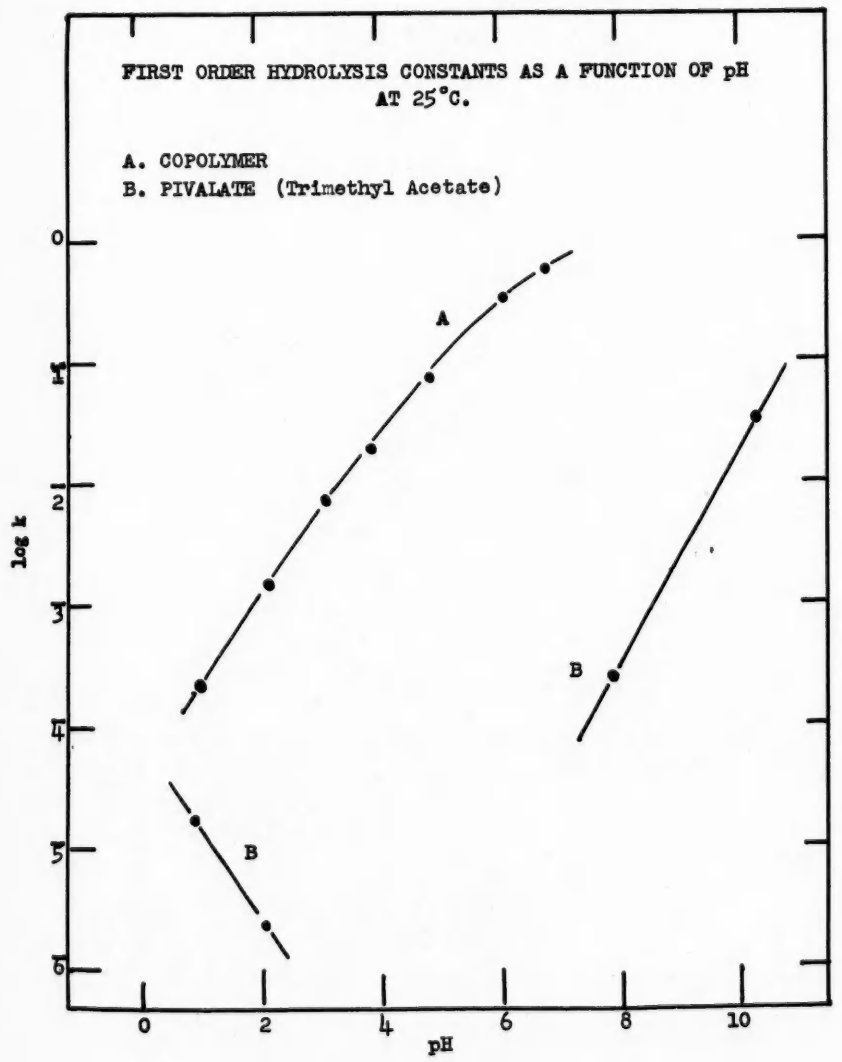


Fig. 1

The methanolysis of copolymers of p-nitrophenyl methacrylate and methacrylic acid do not yield simple first order kinetics with respect to ester concentration. In addition to a slow reaction which is comparable in rate to that of the acrylic acid copolymers, there is a fast reaction which may be due to a confinement of some of the ester groups in a "cage" formed by a methyl group and a carboxyl group of the neighboring monomer, thus subjecting these ester groups to more frequent collisions with the carboxylate ion.

The high reactivity of these copolymers suggests an analogy to the reactions of enzyme-substrate association complexes, and the ease with which copolymers carrying reactive side chains can be prepared could perhaps make them useful as simplified models for the study of some aspects of enzyme catalysis.

141 pages. $1.76. Mic 56-1656

CHEMISTRY, BIOLOGICAL

HISTORADIOGRAPHY: THEORY, PROCEDURES, AND APPLICATION (PARTS I-V)

(Publication No. 16,154)

Jackson Joshua Clemmons, Ph.D.
The University of Wisconsin, 1956

Supervisors: Professors D. M. Angevine and Karl Paul Link

The study of biological substances on a cellular level is becoming increasingly important for the understanding of normal and pathological phenomena. Development of microspectrophotometric methods by Caspersson and histo- and cytochemical procedures by Linderstrom-Lang have advanced our knowledge of cell physiology. Quantitative historadiography is a technique that is now included with the microspectrophotometric histochemical procedures. It is a method whereby the mass of histological structures as small as one micron in diameter can be determined in situ. The magnitudes involved are 10^{-11} to 10^{-12} grams. A determination of the dry weight of cellular structures is useful for the following reasons: (a) It forms a basis upon which results obtained from other histochemical techniques may be expressed. (b) It provides a method for the in situ water determination of cellular structures. (c) The determination of weight loss following the action of selective enzymes or solvents enables an estimate of the concentration of various cell components.

The historadiographic determination of mass is based upon the fact that structures in a thin section of tissue will absorb X-rays in exponential proportion to their mass. In order to have absorption of X-rays by the thin tissue section, it is necessary to use long wavelength X-rays (8-12Å). With a known reference or group of standard protein concentrations in the form of very thin films, a calibration curve representing X-ray absorption versus protein concentration can be constructed. Thin protein standards are difficult to prepare: therefore, a method

has been described for the use of thin nitrocellulose foils. The reference system and tissue are exposed simultaneously to X-rays and the historadiograph recorded on extremely fine-grained Lippman emulsion. The radiograph is then scanned with a microdensitometer to determine the degree of X-ray absorption by the reference wedge and the histological structures. Correcting equivalent nitrocellulose absorption of the unknown structures to equivalent protein absorption enables a calculation of mass.

Historadiography has had serious limitations to overcome before it could be used as a reliable histochemical procedure. By redesigning the apparatus and introducing new principles it has been possible to develop historadiography into one of the more accurate histochemical procedures. The procedures and instruments designed to achieve this accuracy are described. A thorough discussion of errors is undertaken, and the following factors have been demonstrated to influence greatly the reliability of the technique: mass of the sample, accuracy of the reference system, X-ray tube potential, accuracy of the mass absorption constants, photometric errors, film inhomogeneity, and specimen inhomogeneity.

The bulk of the thesis deals with theory, instrumentation, and procedures; two sections, however, are devoted to application. A study was made of estrogen-induced changes in nuclear volume and chemical composition of rat uterine gland and surface epithelium cell nuclei. It was found that estrogen produced a doubling in nuclear volume. Changes in nuclear volume and nuclear mass could be related by a simple equation. This equation enabled an estimate of the histone and non-histone proteins within the nucleus.

Historadiography was also applied to studies on the calcifying matrix. By correlating historadiography with other histochemical procedures it has been possible to obtain further insight into changes required for the deposition of calcium in the early stages of bone formation. The maturation of the cartilage matrix is accompanied by a gradual increase in density. This density may increase 3 to 5 times and is not caused by an increase in protein and polysaccharide concentration. This change is accompanied by an increase in phosphatase activity. The sequence appears essential for the gradual deposition of calcium, which secondarily contributes the greatest change in the matrix density. The matrix of well calcified cartilage is of about the same density as bone matrix.

266 pages. $3.33. Mic 56-1657

AN ELECTROPHORETIC AND ULTRACENTRIFUGAL STUDY OF THE CHYMOTRYPSIN SYSTEM; ITS ACTIVATION AND CHEMICAL MODIFICATION

(Publication No. 16,634)

Richard Egan, Ph.D.
University of Maryland, 1955

Supervisor: Dr. William R. Amberson

Using countercurrent electrophoresis both commercial and repeatedly recrystallized α chymotrypsin preparations are shown to be heterogeneous at all hydrogen ion concentrations about pH 2.9. There are two main electrophoretic peaks but the first gives evidence of its composite nature. This polyphoretic behavior is attributed to the presence of β and γ chymotrypsin by the following facts: each peak is associated with chymotryptic enzymatic activity, although the specific activity varies between these components; changes in the electrophoretic mobility of the peak of maximum activity correspond with the pH-mobility curves of α, β and γ chymotrypsin. Electrophoretic experiments wherein variable amounts of α, β and γ are combined demonstrate that β and γ appear in peak one.

Correlation of electrophoresis and ultracentrifugation data indicate that the electrophoretic separation takes place because of variable electroviscous effects brought about by differences in the state of molecular aggregation.

When the schlieren area distribution is corrected to "ideal" conditions, α chymotrypsin is shown to comprise 91% of the total protein. The electronic valence has been calculated using the Gorin-Henry modifications of the Debye-Hückel theory. At pH 4.6 the chymotrypsin monomer has an effective valence of five positive charges. The isoionic point is shown to be at pH 8.9, whereas the isoelectric point in 0.05 ionic strength buffers occurs at pH 8.5.

An electrophoretic analysis of the activation of chymotrypsinogen demonstrates that the products of the rapid activation can be varied in a systematic fashion depending on the molarities of zymogen and trypsin. Variable amounts of α chymotrypsin and δ chymotrypsin result. An intermediate in the formation of δ can be seen under certain conditions. In the presence of chymotrypsin inhibitors there is no conversion to α or δ, although two other active chymotrypsins (π and X) result. An activation scheme is presented: π chymotrypsin results from a tryptic hydrolysis of chymotrypsinogen; α and δ appear after a chymotryptic hydrolysis of π chymotrypsin. The origin of the other electrophoretic forms, namely x and y, is discussed.

Ultracentrifugation studies of α chymotrypsin at various hydrogen ion concentrations and after photooxidation in the presence of methylene blue lead to the conclusion that an electrostatic linkage between a carboxylate ion of one of the dicarboxylic amino acids and an ionized imidazole is required for dimerization. The fact that diisopropylphosphorofluoridate inhibited chymotrypsin dimerizes with a different pH dependence has been interpreted to mean that the pKa of the imidazole group has been raised by hydrogen bonding. Evidence from electrophoresis shows that the diisopropylphosphoryl moiety in the inhibited enzyme is not bound at the imidazole nucleus.

During photooxidation at pH 7.0 the rate and extent of oxygen uptake as well as the loss of histidine is twice as great in chymotrypsin than in diisopropylphosphorofluoridate inhibited chymotrypsin. Since the presence of a charged histidine residue appears to inhibit photooxidation, these data have also been interpreted to indicate a modified imidazole nucleus on the inhibited enzyme.

162 pages. $2.03. Mic 56-1658

BIOLOGICAL STUDIES ON STABLE AND RADIOACTIVE RARE EARTH COMPOUNDS

(Publication No. 13,195)

Daniel M. Ekstein, Ph.D.
Polytechnic Institute of Brooklyn, 1956

The distribution of lanthanum as representative of the rare earths was studied in the mammalian organism with a view towards the possible use of radioactive rare earths as palliative agents in the treatment of cancer. Stable lanthanum, containing radioactive La^{140} as a tracer was administered to experimental animals in the ionized form as the chloride and the citrate and as a tightly bound complex as the versenate by various routes. These routes were intravenous, intracavitary, and subcutaneous. In addition, lanthanum chloride was administered intravenously and intrapleurally to human patients. Analyses were carried out by radioassays of tissue and excretion samples and by autoradiography of tissue samples.

It was found that approximately 65% of the lanthanum administered intravenously as the chloride and citrate was taken up by the liver. There was no significant uptake by tumor tissue. The distribution pattern could be modified by controlling the amount of material administered. When lanthanum versenate was administered, a more uniform distribution took place.

Lanthanum chloride and citrate remained at the site of administration upon intracavitary and subcutaneous injections, indicating its use as a palliative agent in localized areas. When administered intrapleurally to a patient, the lanthanum remained within the cavity and concentrated within the cancer-white blood cell fraction of the fluid.

Therapeutic doses of radioactive lanthanum were administered intraperitoneally to mice bearing Ehrlich ascites tumors. It was found that this administration increased the life span of these animals significantly over that of the control animals.

Emission spectroscopy studies were undertaken to determine if rare earths other than lanthanum give distribution patterns similar to that of lanthanum. A "master solution" containing La, Nd, Pr, Sm, and Y of known concentrations were injected intravenously into mice. Spectrographic analysis showed that there was no significant change in the concentration ratios of these elements within the tissues analyzed, indicating that the rare earths and yttrium follow a distribution pattern similar to that of lanthanum. 151 pages. $1.89. Mic 56-1659

THE QUANTITATIVE ESTIMATION OF BACTERIAL FATTY ACIDS

(Publication No. 16,513)

Dov Ber Issachar Henis, Ph.D.
University of Pittsburgh, 1956

A quantitative method for the estimation of saturated, monoethenoid and branched-chain fatty acids in small samples of bacterial cells was developed in order to gain insight into the metabolic interplay between the various fatty acids in bacteria, and to investigate the effect of alterations of the culture medium upon the fatty acid spectrum of microorganisms.

The method involves (a) isolation of the lipides from the bacteria by acid or sodium hydroxide hydrolysis, (b) saponification of the lipides to liberate the fatty acids (a 25 to 60 mg. sample of fatty acids is sufficient for one determination), (c) hydroxylation of the fatty acids with performic acid, and (d) separation of the resulting mixture of hydroxylated fatty acids by reversed phase chromatography on rubber columns. The fixed phase of the column consists of "Mealorub" swollen with petroleum ether, and the moving phase consists of acetone-water mixtures of increasing acetone content. The individual, saturated fatty acids are eluted from the column in decreasing order of their molecular weight, following the initial elution of the "dihydroxy" fatty acids. This technique brings about a clean separation of the hydroxylated fatty acids from the saturated fatty acids above caprylic acid. Stearic and lactobacillic acids are not separable by this chromatographic method, and accumulate in a fraction designated as the $(C_{18}+C_{19})$ fraction. The lactobacillic acid content of this fraction is readily determined by microbiological assay with Lactobacillus delbrueckii. Stearic acid does not interfere with the microbiological assay. The proportions of unsaturated octadecanoic and hexadecanoic acids are determined by subjecting a fatty acid sample to catalytic hydrogenation prior to chromatography. Hydrogenation converts the unsaturated octadecanoic acids into stearic acid, whereas the unsaturated hexadecanoic acids are transformed into palmitic acid. Thus, the difference in the palmitic acid and the $(C_{18}+C_{19})$ bands between a hydroxylated and a hydrogenated sample of a mixture of fatty acids of unknown composition provides a measure of its content of both C_{16} and C_{18} unsaturated fatty acids.

The application of this method to the separation of synthetic mixtures of fatty acids is described, as well as the determination of the fatty acid spectrum of Lactobacillus arabinosus, Lactobacillus casei, Lactobacillus delbrueckii, Agrobacterium tumefaciens, and a Streptococcus species. The lipides of these organisms were found to contain large proportions of palmitic acid and monounsaturated fatty acids of a chain length of 16 and 18 carbon atoms; only small proportions of lower fatty acids (10 to 14 carbons) were observed. Lactobacillic acid was found to be present in four of the organisms; the substance was not detected in the lipides of the Streptococcus. The lactobacillic acid content of the lactic acid bacteria studied was highest in L. arabinosus (30 per cent of the fatty acids) and lowest in L. delbrueckii (10 per cent of the fatty acids). Alterations in the composition of the culture medium were found to produce marked changes in the fatty acid spectrum of L. delbrueckii.

Incorporation of Tween 40 into the culture medium of this organism, in the presence of biotin, resulted in an increased palmitic acid content of the cells and in a decrease of the proportion of unsaturated fatty acids. When L. delbrueckii was cultured on a Tween 40-containing medium, in the presence of oleic acid and in absence of biotin, a large amount of palmitic acid was present in its lipides; a decrease in the $(C_{18}+C_{19})$ fraction and an increase in the "dihydroxy" band was apparent also.

The results of this investigation have demonstrated that L. delbrueckii is not dependent on biotin for the production of lactobacillic acid, and that the incorporation of a palmitic acid-Tween ester into its medium brings about marked alteration in its total fatty acid content as well as in its fatty acid spectrum. 68 pages. $1.00. Mic 56-1660

THE EFFECTS OF DIETARY LIVER ON THE THYROID METABOLISM OF THE RAT

(Publication No. 16,472)

Derek Rowland Highley, Ph.D.
Purdue University, 1956

Major Professor: Herbert E. Parker

Liver is widely used as a supplement to animal feeds because it is a potent source of essential nutritional factors. In addition to furnishing dietary essentials, liver feeding has frequently been reported to cause profound changes in the metabolism of the animal. One of the most widely studied changes produced by dietary liver is its effect on thyroid function. The purpose of this investigation has been to study the mechanism by which dietary liver modifies thyroid function and to attempt to identify the liver component(s) responsible for it.

The water insoluble fraction of liver was found to cause significant thyroid enlargement when fed to iodine deficient weanling rats for six weeks. This was accompanied by a reduction in the protein bound iodine stores in the thyroid glands of these animals. When water insoluble liver was fed to rats receiving adequate dietary iodine the thyroid enlargement was overcome and their thyroid glands contained more protein bound iodine than those of the corresponding control animals. Furthermore, a two-fold increase in plasma protein bound iodine was observed without a detectable increase in basal metabolic rate.

The uptake and release of I^{131} by the thyroids of intact rats at increasing intervals of time after injection of the tracer was used to further study the mode of action of the substance(s) in water insoluble liver which modified thyroid function. It was found that at least two mechanisms were involved, one of which reduced thyroid activity and another which caused thyroid activation. The thyroid inhibiting entity was detectable when water insoluble liver was fed for only nine hours prior to I^{131} injection. If, however, the length of time water insoluble liver was fed before I^{131} injection was increased to three days, significant thyroid activation was observed. Both the accumulation of I^{131} and the secretion rate of I^{131}-labeled thyroxine by the thyroid gland were significantly increased.

The ash of water insoluble liver greatly reduced the uptake of I^{131} by the rat thyroid gland. There is a possibility that a constituent of the ash was responsible for the inhibitory effect observed when water insoluble liver was fed for nine hours before I^{131} injection. Autoclaved water insoluble liver and ethanol soluble, water insoluble liver, when fed for three days or longer, had the same effect on thyroid I^{131} uptake as that observed when water insoluble liver was fed for nine hours prior to the injection of the tracer. Apparently autoclaving or ethanol extraction of water insoluble liver caused partial destruction of the thyroid activating principle which permitted the thyroid inhibiting effect to be detected.

Although water insoluble liver caused reproducible increases in the accumulation of I^{131} and in the secretion of I^{131}-labeled thyroxine by the rat thyroid, when fractionation of the material was attempted, interpretation of the results obtained with the radioactive assay methods was difficult and uncertain. The relatively large animal variation was the chief cause of difficulty. The source of variation could not be traced to litter, body weight, thyroid weight, or food consumption. Screening of the animals for thyroid activity before assay indicated that there were unpredictable changes in thyroid activity between screening and actual assay. It was found that the use of a more highly purified basal diet composed primarily of casein and cerelose caused a substantial reduction in animal variation and an increase in the difference observed due to liver feeding. Fractionation attempts using different solvents and acid hydrolysis were either unsuccessful in solubilizing the thyroid activating principle or caused it to be partially inactivated.

When diets containing water insoluble liver were fed to rats supplemented with either vitamin A or β-carotene, significant increases in liver vitamin A storage were observed. Evidence was obtained which indicated that this may have been accompanied by an increase in the concentration of steroids in their livers. These findings together with the fact that the level of circulating thyroxine was increased without a corresponding increase in basal metabolic rate indicate that dietary water insoluble liver may reduce the effectiveness of thyroxine. It is suggested that the decreased effectiveness of circulating thyroxine was the cause of thyroid activation found in rats fed diets containing water insoluble liver.

Experiments with autoradiograms were performed to determine if changes could be detected in the distribution of I^{131} in the thyroid glands and plasma of rats fed water insoluble liver. Changes in the distribution of radioactivity in the hydrolysate of thyroid gland protein were observed as a result of feeding the liver fraction. This was also found to be the case with the free amino acids of the thyroid gland. In addition, differences occurred in the location of spots reacting with ninhydrin. Thyroxine was found to be the only detectable iodine containing amino acid of thyroid origin occurring in the plasma of rats fed either the basal or water insoluble liver containing diets.

108 pages. $1.35. Mic 56-1661

INVESTIGATION OF THE SODIUM HYPOCHLORITE OXIDATION OF METHYL 4-O-METHYL-D-GLUCOPYRANOSIDES

(Publication No. 16,475)

Stanley J. Kazeniac, Ph.D.
Purdue University, 1956

Major Professor: Roy L. Whistler

Methyl 4-O-methyl-β-D-glucopyranoside and methyl 4-O-methyl-α-D-glucopyranoside were prepared as model substances for cellulose and starch, respectively, and treated in solution with 10 equivalents alkaline sodium hypochlorite per mole of sugar derivative buffered at pH 9 and 25° C. From the reaction mixture of the β-anomer, the disodium salt of 2-O-methyl-3-O-(glyoxylic acid methyl acetal)-D-erythronic acid was isolated in 30% yield by chromatography on cellulose column and identified through its hydrolysis products, glyoxylic acid and 2-O-methyl-D-erythronic acid lactone. In other experiments, glyoxylic acid was found in yields of 43-47% in the reaction mixture, indicating a still greater degree of C_2 and C_3 glycol type cleavage. Glyoxylic acid was

determined by gravimetry as the 2,4-dinitrophenylhydrazone and by colorimetry as the colored sodium hydroxide-2,4-dinitrophenylhydrazone complex.

Glyoxal was also recovered in 10% yield as the 2,4-dinitrophenylosazone derivative from an acid hydrolyzate of the oxidized β-sugar mixture. The intermediate that yielded glyoxal appeared early in the reaction and did not increase appreciably in amount during the remainder of the reaction.

Under these conditions about 10% of the original β-sugar was unreacted. Neither uronic acid nor glyconic acids were detected in the oxidation mixture.

Oxidation of the α-anomer under the same conditions appeared to follow a similar course, but at a much slower rate. The α-sugar was found to be more resistant than the β-anomer to attack from alkaline sodium hypochlorite, by changes in optical rotation, by levels of oxidant consumed, and by the amount of glyoxylic acid formed.

The ratio of glyoxylic acid produced to oxidant consumed was determined at different stages of the oxidation period for both the α-, and β-anomers of methyl 4-O-methyl-D-glucopyranoside. Glyoxylic acid was detected in the early stages of the reaction, and its rate of formation seemed to remain constant.

64 pages. $1.00. Mic 56-1662

THE ANTIOXIDANT ACTION OF ELECTRON ATTRACTING AND ELECTRON REPELLING SUBSTITUENTS IN THE 2 AND 6 POSITIONS OF PHENOL

(Publication No. 16,481)

Glenn Joseph Miller, Ph.D.
Purdue University, 1956

Major Professor: Dr. F. W. Quackenbush

After a patent had been issued for the use of butylated cresol as an antioxidant in petroleum products, there were many patents issued for the commercial syntheses of alkylated phenols but there were no reports of systematic studies of these phenols as antioxidants until 1950. Although there is still some confusion as to the correlation of antioxidant activities in petroleum products with structures of alkylated phenols, it is agreed that bulky alkyl groups in the 2,6 positions of phenol were the most effective and that optimum activity was obtained with bulky alkyl groups in the 2,6 positions if the 4 position was occupied by a methyl or methylene group. The same general results were obtained using dried lard as substrate instead of petroleum products, but in addition, it was noted that certain groups other than alkyl groups, i.e. iodo, nitro, imparted no antioxidant activity to phenol. Since this did not agree with the postulated steric hindrance action of the bulky alkyl groups it was decided to synthesize phenols containing various non-alkyl groups and to test their activity in a bleached, deodorized and dried lard. In order to maintain a basic nucleus for the study, the compound 4-methylphenol was used as the starting material for all syntheses except two, in which a propionyl or a propyl group were present in the 4-position.

The importance of a free phenolic hydroxyl was determined by esterifying two phenols that were active as antioxidants in lard and determining the activities of the esters. Both esters were inactive proving that a free hydroxyl was necessary for activity in lard. It had previously been reported that the first step in the mechanism of the phenolic antioxidants was probably the removal of a hydrogen radical from the phenolic hydroxyl. The results obtained with the esters and the mentioned report assured that any differences in antioxidant activity caused by the presence of the different groups studied were due to the effects of these groups on the hydroxyl.

All of the 4-alkylphenols containing electron attracting groups in the 2,6-positions were inactive. All those containing electron repelling groups in the 2,6-positions were active. The explanation for this is believed to be that the electron repelling groups increase the negativity of the phenolic oxygen causing an increased association of the oxygen and the hydrogen which, in turn, causes a decrease in hydrogen ionization. This increased association then seems to favor an increase in the ability of the phenol to release hydrogen radicals. Electron attracting groups cause the opposite conditions to occur and therefore do not impart antioxidant activity to the phenol.

The most active of the phenols tested was 2,6-di-tert-butyl-4-methylphenol. A literature search failed to reveal whether the tert-butyl group is more or less electron repelling than the other electron repelling groups studied, but it is apparent that this group is larger than the others. Therefore, it may be that maximum activity is obtained when the electron repelling groups are bulky. Most likely the steric hindrance of the bulky electron repelling groups augments the effect of electron repulsion thereby increasing antioxidant activity.

A mechanism for the antioxidant action of 2,6-di-tert-butyl-4-methylphenol in petroleum oil has recently been proposed which involves the methyl group of the phenol initially rather than the hydroxyl. This was suggested after the compounds 1,2-bis(3,5-di-methyl-4-hydroxyphenyl) ethane and 3,5,3',5'-tetra-tert-butylstilbene-4,4'-quinone were isolated from oxidized petroleum oil to which 2,6-di-tert-butyl-4-methylphenol had been added prior to oxidation. Since the mechanism might also apply to lard, attempts were made to isolate the two compounds from oxidized lard which contained the phenol before being oxidized, but all attempts were unsuccessful. By the use of the characteristic absorption spectrum of the stilbene quinone in the region 410-470 millimicrons it was shown that this quinone was not present in the oxidized lard which indicated then that the suggested mechanism was not applicable to lard. Parallel studies using mineral oil as the substrate instead of lard showed that the mechanism was not evident in this substrate either. However, there is an indication that the mechanism may be applicable to other types of alkyl phenols in lard. An oxidation product of bis(3,5-di-methyl-4-hydroxyphenyl)methane was isolated from oxidized lard to which the bisphenol had been added prior to oxidation. Polarographic, infrared and antioxidant activity studies have suggested that the product is a monoquinone of the parent bisphenol. The structure postulated for this intermediate is 1-(3',5'-di-methyl-4'-hydroxybenzylidene)-3,5-di-methyl-(2,5)-cyclohexadiene-(4)-one. If this structure is correct, then the suggested mechanism may be applicable to this type of phenol in lard.

40 pages. $1.00. Mic 56-1663

PART I: THE LOBRY de BRUYN TRANSFORMATION OF D-GLUCOSE AND 3,4,6-TRIMETHYL-D-FRUCTOSE
PART II: KINETICS OF THE METAL ION CATALYZED DEGRADATION OF DL-GLYCERALDEHYDE

(Publication No. 16,742)

Don Shuso Miyada, Ph.D.
Michigan State University, 1953

The base catalyzed degradation of D-glucose was studied kinetically in sodium hydroxide solutions by two methods of analysis of the reaction mixtures involving specific oxidation and the optical rotation of such mixtures. The implications of the results are discussed.

The base catalyzed degradation of 3,4,6-trimethyl-D-fructose in dilute solutions of calcium, barium, and sodium hydroxides was investigated. There appeared to be no difference in the trend of formation of the methylated products with the three bases; however, in solutions containing alkaline earth bases, a steady increase in periodate consumption was observed which was probably caused by the demethylation of the methylated hexoses. A comparison of the effect by these bases in the enolization reaction indicated that hydroxyl ion catalysis predominates.

A new set of values for the catalytic constants of acetic acid and acetate ion was obtained for the general acid-base catalyzed degradation of glyceraldehyde, and the dependency of the reaction rate on ionic strength was determined. The effect of metal ion catalyzed degradation of glyceraldehyde was investigated using the following metal ions: lithium, calcium, barium and magnesium. An acceleration in the rate of reaction was observed in all cases except with magnesium ion where increased metal ion concentration produced a diminution of the pseudo first order rate constant. A mathematical treatment of the catalysis by calcium ion, based on (1) incomplete dissociation of the species $CaOAc^+$ and (2) the limitation of catalysis by the calcium acetate system to calcium and acetate ions, was found to give pseudo first order rate constants which compared favorably with experimentally determined values as well as a reasonable dissociation constant for the species, $CaOAc^+$. 94 pages. $1.18. Mic 56-1664

METHODS AND RESULTS OF SPECTROCHEMICAL ANALYSIS OF BIOLOGICAL MATERIALS

(Publication No. 16,690)

Neil Frederick Shimp, Ph.D.
Rutgers University, 1956

Quantitative spectrochemical procedures for the simultaneous analysis of 20 inorganic elements in a wide variety of biological materials were developed. Details of the procedures were given for both trace and major constituents and the methods shown to apply to plant materials and human tissues.

Chemical pretreatment prior to spectrographic analysis was found necessary for the adjustment of samples to a constant chemical matrix. The spectrochemical procedures developed adhered to a constant chemical matrix regardless of the composition of the original sample. Samples were adjusted to a final chemical composition very similar to that of analytical standards.

Two techniques were used for this purpose. One was a buffer procedure in which samples were wet digested and buffered by at least 20 times their own ash weight of $NaNO_3$. The resultant impurities in the $NaNO_3$ were determined by analysis of the mixture in the A. C. arc. Al, Ca, Cu, Fe, K, Mg, Mn, and Sr were spectrographically determined by this procedure.

The other procedure was a precipitation technique that concentrated and isolated certain of the trace elements from their original matrix. This procedure was used for the spectrographic determinations of Bi, Cd, Co, Cr, Ga, Mo, Ni, Pb, Sn, Ti, V, and Zn. The digested sample was taken up in HCl and the metal complexing agents 8-quinolinol, thionalide, and tannic acid were added. These reagents quantitatively precipitated the elements from a buffered solution. Carriers of Al and Fe were added to the solution to facilitate complete precipitation and to serve as a constant matrix for the spectrographic analysis. This procedure concentrated the metals into a relatively small precipitate of Al and Fe quinolates. The precipitates were dry ashed and mixed with spectrographically pure graphite containing the internal standards Pd and Ge. The trace metals were then analyzed spectrographically by the D. C. arc as impurities in the resulting Al_2O_3-Fe_2O_3 carbon mixture.

Wide applications of the procedures, without alteration of original analytical standards, were made by analyses of a large number of human tissues and plasma. The procedures were also shown to apply equally well to plant materials. Spectrochemical analyses of inorganic elements were reported for normal and cancerous human tissues and serve as a base line for future investigations. Cd was established as a normal constituent in human kidney and other body tissues. Certain cancerous human tissues were shown to exhibit a marked capacity to accumulate certain trace elements.

Chemical and spectrochemical comparisons for Cu, Fe, Mg, and Zn in human tissues were made and the two sets of data were shown to compare favorably. Precision of the spectrochemical methods was shown to be about $\pm 10\%$ for most elements under analysis.

Simultaneous spectrochemical analyses for a large number of inorganic elements, both major and trace, were shown to be of great usefulness in the study of biological systems. 112 pages. $1.40. Mic 56-1665

CONFORMATION CHANGES IN BOVINE PLASMA ALBUMIN ASSOCIATED WITH HYDROGEN ION AND UREA BINDING

(Publication No. 16,493)

Melvin David Sterman, Ph.D.
Purdue University, 1956

Major Professor: Joseph F. Foster

The conformation of plasma albumin in 2M urea solution has been investigated by measurement of intrinsic viscosities and of specific rotations (extrapolated to zero

concentration) over the pH range 2 to 6 both with and without added NaCl. These results parallel the results obtained by Yang and Foster J. Am. Chem. Soc., 76, 1588 (1954) in solutions lacking urea. However, the increase in intrinsic viscosity and levorotation begins at higher pH values (pH 5) and is larger in the presence of urea than in its absence. Added electrolyte causes a depression of both the intrinsic viscosities and specific rotations. Extrapolation of the data to zero ionic strength yields a monotonic sigmoidal curve when either set of data is plotted against pH. The changes in intrinsic viscosity and specific rotation were shown to be reversible by removal of the urea, acid and salt by dialysis.

The intrinsic viscosity data have been interpreted in terms of the hydrodynamic volume of the protein molecule and the data are consistent with a twenty fold increase in volume at pH 3. The viscosity results are analogous to those obtained for synthetic polyelectrolytes. The optical rotation is considered to be the resultant of two factors: (1) the number of asymmetric centers in the molecule, and (2) the conformation of the polypeptide chain and its effect upon the spatial orientation of the asymmetric centers. The changes in specific rotation are interpreted as involving the transition from a highly ordered, compact conformation at the isoionic point to a more random spatial configuration at low pH.

It was concluded that an expansion of the molecule occurs in acid and in urea solution in which there is a rearrangement in the folding of polypeptide chain; however, the expanded molecule must retain an element of its molecular integrity. It is suggested that urea ruptures a portion or all of the intramolecular hydrogen bonds in the protein molecule and is bound to the protein in the process.

Studies were conducted to discern the effect of urea concentration – OM, 2M, 5M and 8M – and ionic strength – 0.01, 0.02 and 0.10 – upon the acid titration curves for plasma albumin. In the absence of urea normal sigmoidal titration curves are obtained. However, in the presence of urea the titration curves show two distinct binding regions and the total number of protons bound is much larger than expected from the number of carboxyl groups in the molecule. It is suggested that urea is hydrogen bonded to the peptide linkages of the protein molecule causing an increase in basicity of the bound urea and resulting in the binding of protons by the bound urea at low pH.

The value for the intrinsic dissociation constant, pK'_o, of the carboxyl groups in the molecule was evaluated directly from the titration data. The pK'_o values observed were interpreted as indicating the existence of a specific salt bridge type interaction between the basic form of the carboxyl groups and the ϵ-ammonium groups in the molecule. It is suggested that urea destroys this specific salt bridge type interaction with the result that the carboxyl group then behaves as if it were an independent, dissociating unit, isolated from all external influences. The ionic strength effect is most pronounced in the absence of urea and least significant in concentrated urea solution. Furthermore, there is an increase in pK'_o with increasing ionic strength as would be predicted by theory.

Insight into the conformation of the molecule is obtained from the parameter w which is related to the dimensions of the molecule. It is concluded that the molecule undergoes an expansion in acid and in urea solution in agreement with the conclusions reached from the specific rotation and intrinsic viscosity data. A detailed discussion of the expansion process is given and it is suggested that in the absence of urea the expansion of the molecule results from the destruction of the specific salt bridge type interactions and the attendant increase in charge on the molecule with decreasing pH causing a large electrostatic repulsive potential to exist in the molecule. In urea solution the expansion is due primarily to the destruction of the extensive network of intramolecular hydrogen bonds. The destruction of the specific salt bridge type interaction is of secondary importance and the charge effect would appear to be inconsequential in urea solution.

179 pages. $2.24. Mic 56-1666

CHEMISTRY, INORGANIC

THE DETERMINATION OF GERMANIUM BY FLUORESCENT X-RAY SPECTROGRAPHY

(Publication No. 16,632)

William Joseph Campbell, Ph.D.
University of Maryland, 1956

Supervisor: Dr. Charles E. White

A fluorescent x-ray spectrograph has been modified to permit resolution of spectral lines without a prohibitive loss of line intensity. The spectrometer consists of a quartz or topaz analyzing crystal and a Soller slit collimator composed of thin molybdenum plates. A molybdenum target x-ray tube is used as the source of excitation in order to reduce interfering lines and background. A standard argon Geiger tube is very efficient for the germanium K spectrum and is insensitive to the shorter wavelength second order lines that may overlap the analytical lines. The use of scintillation counters was found to be unsatisfactory, since the noise level is high and the detector is very sensitive for the shorter wavelengths which may interfere with the germanium K spectrum.

From basic theoretical considerations the following relationship between line intensity and concentration of the analytical element is derived:

$$I_{GeK\alpha_1} = \frac{K N_{Ge}}{\mu_E + \mu_{GeK\alpha}} \qquad (1)$$

where N_{Ge} = atomic percentage of germanium

μ_E = linear absorption coefficient for exciting radiation, the effective value is assumed to be 1.0 A

$\mu_{GeK\alpha}$ = linear absorption coefficient of matrix for germanium Kα radiation

Four general methods of analysis are described in which the above expression is applied. The first of these involves a comparison of the relative intensities of the germanium Kα_1 line from unknown and standard samples. This method is suggested for qualitative analysis only

since the accuracy is limited to ± 20% of the amount present due to the complexity of the samples.

The second method consists of the addition of a reference element with physical properties similar to the element under determination. Matrix effects on the comparison lines ratio were found to be less than ± 3% except when preferential absorption or excitation occurred. By a proper choice of reference element these undesirable effects can be minimized or eliminated. Errors due to particle size are reduced by wet grinding with an added abrasive or by chemical fusion. This internal standard procedure was found to be accurate to ± 10% for samples greater than 0. 1% in germanium content.

A third or additive technique was developed in which the intensity of the GeKα_1 is measured before and after addition of a known amount of the oxide. This method requires very little sample preparation, is accurate to within ± 10% provided the amount present is above 0. 1% germanium.

The fourth method consists of a preliminary separation of the germanium by distillation as the tetrachloride followed by precipitation as a cinchonine germanomolybdate. The precipitate is collected on filter paper which is placed in the primary x-ray beam. The lower limit of detection is approximately 1 ppm. in coal ash and 0. 02 to 0. 03 ppm. in coal with an accuracy of ± 5% germanium in samples containing over 0. 03% germanium.

Studies on the reported loss of germanium upon thermal ashing show that no detectable amounts are lost below 600°C. However, if the sample is placed into a muffle furnace at 900 to 1000°C. 50 to 100% of the element is lost as a volatile constituent.

Some work was undertaken to determine the chemical form of germanium in coals. Results indicate that the element in the lignites of the College Park area is possibly in the form of hexagonal germanium dioxide.

156 pages. $1.95. Mic 56-1667

COPRECIPITATION FROM HOMOGENEOUS SOLUTION WITH FERRIC PERIODATE AS CARRIER

(Publication No. 16,652)

Leonard Ginsburg, Ph.D.
Syracuse University, 1956

A procedure was developed for the precipitation of ferric periodate from homogeneous solution. An acidic solution containing ferric ion and paraperiodic acid is homogeneously neutralized by the hydrolytic action of acetamide. Iron can be quantitatively precipitated by this technique. The physical properties of the precipitate so obtained were found to be highly superior analytically to those of the precipitate formed by conventional techniques of dropwise addition of a precipitant. The precipitate from homogeneous solution is dense, filterable, and easily washed. An exploratory study of the microscopic appearance and X-ray diffraction properties of the precipitate was made.

The possibility of separating iron from aluminum by this method was investigated. A quantitative separation could be achieved in cases where the mixture contained 35% aluminum or less. With more aluminum a two-stage precipitation procedure was necessary.

A study was made of the coprecipitation of aluminum from initial aluminum concentrations of approximately 10^{-4} M. The system did not appear to follow either of the two general distribution laws. Coprecipitation was found to be negligible until at least 99.9% of the iron had been precipitated.

The coprecipitation of yttrium with the same carrier was investigated for initial yttrium concentration of 10^{-10} M. Coprecipitation was again found to be negligible until at least 99.9% of the iron had been precipitated. The percentage of yttrium precipitated was found to be independent of a four fold change in the initial yttrium concentration.

For both of the trivalent cation tracers, occlusion during growth of the precipitate was found to play a negligible role in the overall coprecipitation process.

The coprecipitation of zinc with the same carrier was investigated for initial zinc concentrations varying from approximately 10^{-3} to 10^{-5} M. The coprecipitation process in the case of zinc was found to be somewhat more complex. Neither of the two general distribution laws was adhered to by the system. The extent of coprecipitation was found to vary with the initial zinc concentration. Analysis of the data of the zinc study indicated that the system followed the Freundlich isotherm to a moderate extent.

A preliminary investigation of hafnium, titanium, and permanganate ion as tracers was made.

Modifications of the distribution laws pertinent to a divalent cation tracer are presented.

104 pages. $1.30. Mic 56-1668

THE CORRELATION OF CHEMICAL SOIL TESTS FOR AVAILABLE PHOSPHORUS, INCLUDING A PROPOSED METHOD, WITH CROP RESPONSE

(Publication No. 16,643)

James Roland Miller, Ph.D.
University of Maryland, 1956

Supervisor: Dr. J. H. Axley

Chemical methods for determining available phosphorus in soils have been studied for approximately a century. Even though much progress has been made in the development of soil tests for available phosphorus there is still need for many of the tests to be correlated more extensively with crop response data and for the development of chemical methods that are suitable over a wider range of soils.

A field pot culture experiment which consisted of 17 Maryland soils, each treated to five levels of acid soluble phosphorus with 20 per cent superphosphate, was conducted at the University of Maryland Plant Research Farm. This study was used to determine the correlation of phosphorus soil tests with crop response. In addition, phosphorus soil test values and crop response data from three field experiments at different locations in the state were studied for the same purpose. A part of the research was devoted to the development of a chemical method for determining soluble phosphorus in soils.

The proposed method consists of shaking a 2 g. sample of soil for 1 minute in 14 ml. of extracting solution which is 0.03 N with respect to sulfuric acid and 0.03 N with

respect to ammonium fluoride, and determining the phosphorus in an aliquot of the clear filtrate.

The phosphorus removed by alfalfa showed a closer relationship than the yield of alfalfa with the phosphorus extracted from the soils by the different chemical methods.

The proposed method gave the highest correlation with crop response data and next in order were the Bray and Kurtz No. 1 and sodium bicarbonate methods both of which were about equally satisfactory for determining available phosphorus in soils. When the soils receiving rock phosphate were not considered, the modified Truog method gave the best relationship of all the chemical methods studied with crop response data.

The soil series determined to a large extent the correlation obtained between chemically available phosphorus and crop response data.

Levels of extractable phosphorus in the soils for the different chemical methods at which phosphate applications often failed to increase the yields of alfalfa and wheat were: 55 pounds per acre, modified Truog; 55 pounds, Bray and Kurtz No. 1; 35 pounds, sodium bicarbonate; 70 pounds, proposed method.

The modified Truog, Wrenshall and McKibbin, and Mehlich methods extracted approximately one and a half to three times more phosphorus from rock phosphate treated soils than from superphosphate treated ones receiving the same quantity of P_2O_5; yet the yield of corn, wheat, and red clover hay was less when rock phosphate was used.

The quantities of 20 per cent superphosphate required to establish similar levels of chemically available phosphorus in the different soils varied in some cases by a ton or more. 108 pages. $1.35. Mic 56-1669

CHEMISTRY, ORGANIC

STEREOSPECIFIC REACTIONS OF NUCLEOPHILIC AGENTS WITH ACETYLENES AND VINYL-TYPE HALIDES (PARTS I-IV)

(Publication No. 16,450)

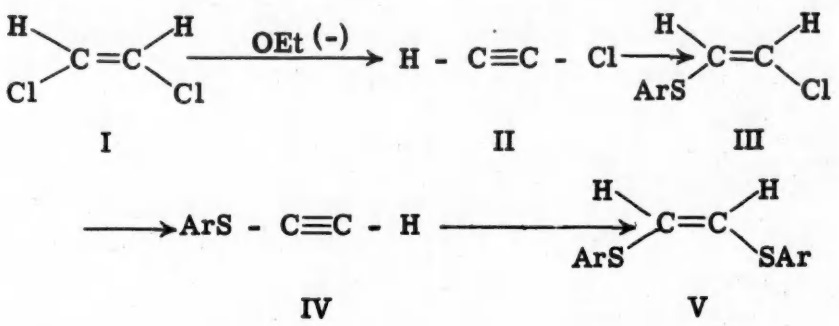
Max Minas Boudakian, Ph.D.
Purdue University, 1956

Major Professor: William E. Truce

I. The Mechanism of the Base-catalyzed Reaction of cis-Dichloroethylene with Thiols.

There are several reports of cis-dichloroethylene (I) reacting with nucleophilic agents such as a benzenethiolate,[1] p-toluenethiolate,[1] 2-methyl-2-propanethiolate[2] and sulfite (see Part IV) ions, while the trans isomer was recovered unchanged.

The purpose of this investigation is to elucidate the mechanism of the reaction between I and sodium p-toluenethiolate which gives cis-1,2-bis(p-tolylmercapto)-ethene (V) as sole product. On the basis of chemical and kinetic evidence, the following sequence is now proposed for this conversion:



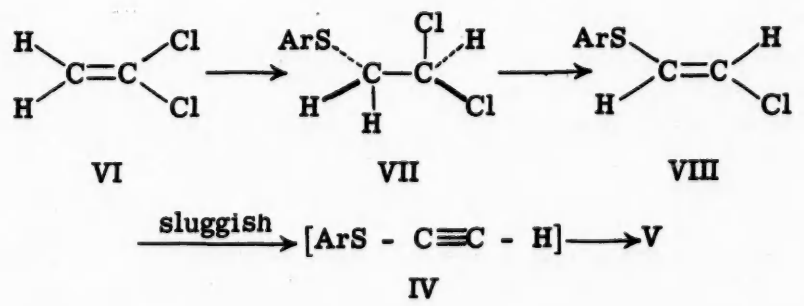
The conversion of I to II in this reaction is supported by (a) the fact that trans-I does not undergo this reaction,[1] (b) the well-known observation that cis-dichloroethylene (I) dehydrohalogenates faster than the trans isomer, and (c) by kinetic studies[3] of the overall reaction, which show that the rate of reaction is pseudo first order and is proportional only to the concentration of the haloölefin and sodium ethoxide; no reaction occurs in the absence of sodium ethoxide.

To verify its intermediacy, chloroacetylene (II) was treated with the thiolate reagent, whereby both III and V were obtained, the relative amount depending on the molar ratio of p-toluenethiol to sodium used. The stereochemistry of III was established by several different criteria. In the forerun of III, the infrared absorption bands for an acetylenic C - H bond (3.08 μ) and an acetylenic C - C bond (4.90 μ) were detected. These same bands were present in an independently synthesized sample of IV. Intermediate III was converted to V when treated with the arylthiolate in the presence of sodium ethoxide; no reaction occurred in the absence of the latter. The conversion of IV to V was unaffected by the presence or absence of free radical inhibitors.

The conversions of chloroacetylene (II) to III, and p-tolylmercaptoacetylene (IV) to V, constitute stereospecific trans nucleophilic additions across an acetylenic bond.

II. The Mechanism of the Base-catalyzed Reaction of Vinylidene Chloride with Thiols.

Since the geometrically isomeric dichloroethylenes exhibited a sharp difference in reactivity toward thiolates (Part I), it became of interest to study the behavior of the isomeric vinylidene chloride (VI) toward this nucleophilic agent. Vinylidene chloride (VI) also gave cis-1,2-bis-(p-tolymercapto)ethene (V) in high yield. Evidence against an initial elimination-addition mechanism such as that obtained with cis-dichloroethylene (I) is presented:



By controlling the reaction conditions, intermediates VII and VIII can be isolated. Intermediate VII was identified by elemental analysis of its sulfone, while VIII was independently synthesized from acetylene and p-toluenesulfonyl chloride. Both intermediates VII and VIII gave V

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upon treatment with sodium p-toluenethiolate in the presence of sodium ethoxide. In the absence of the ethoxide, VIII is not converted to V. On the basis of this base-catalyzed conversion of VIII to V, intermediate IV was postulated. Intermediate IV was previously prepared, and when treated with arylthiolate ion, gave V as a result of a stereospecific trans nucleophilic addition process (Part I).

III. The Reactions of cis- and trans-2-Chloro-2-Butenes with Thiolate and Sulfite Ions.

The reactions of the cis- and trans- 2-chloro-2-butenes with sodium p-toluenethiolate and with potassium sulfite have been studied. The higher-boiling isomer (H and Cl cis) did not react with the arylthiolate in the presence of sodium ethoxide. The lower-boiling trans isomer, which had been previously shown to be more readily dehydrohalogenated, reacted to give trans-2-(p-tolylmercapto)-2-butene. No reaction occurred in the absence of sodium ethoxide. These facts suggest an elimination to 2-butyne as the rate-determining step in the overall conversion. Further support for this mechanism stems from the observation that 2-butyne and sodium p-toluenethiolate react to give trans-2-(p-tolylmercapto)-2-butene.[4]

Even under extremely vigorous conditions, neither cis- nor trans-2-chloro-2-butene reacted with potassium sulfite.

IV. The Reactions of cis-Dichloroethylene, Vinylidene Chloride and Vinyl Bromide with Sulfite Ion.

cis-Dichloroethylene reacts with potassium sulfite to give potassium 1,1,2-ethanetrisulfonate only. The reaction is not affected by free radical inhibitors. Under the same conditions, the trans haloölefin does not react. The fact that only the more readily dehydrohalogenated cis isomer reacts, suggests an elimination-addition mechanism proceeding through chloroacetylene as the first intermediate. Chloroacetylene does indeed react with potassium sulfite to give the same trisulfonate in good yield. A mechanism like that postulated for the analogous reaction between cis-dichloroethylene and sodium p-toluenethiolate (Part I) is also suggested for the reaction of cis-dichloroethylene with potassium sulfite.

Vinylidene chloride also reacts with potassium sulfite to give potassium 1,1,2-ethanetrisulfonate. An addition-elimination mechanism like that postulated for the analogous reaction between vinylidene chloride and sodium p-toluenethiolate (Part II) is also suggested for the corresponding reaction with potassium sulfite.

Instead of the double salt $(CH_2 = CH{\cdot}SO_3K)_2 \cdot KBr$, which was previously reported by Kohler[5] for the reaction between vinyl bromide and potassium sulfite, potassium 1,2-ethanedisulfonate is the only product.

BIBLIOGRAPHY

1. W. E. Truce and R. J. McManimie, J. Am. Chem. Soc., 76, 5745 (1954).
2. H. J. Backer and J. Strating, Rec. trav. chim., 73, 565 (1954).
3. Richard F. Heine, M. S. Thesis, Purdue University, 1955.
4. John A. Simms, Ph.D. Thesis, Purdue University, 1955.
5. E. P. Kohler, Am. Chem. J., 19, 728 (1897).

186 pages. $2.33. Mic 56-1670

THE DETECTION OF BISMUTH WITH DITHIZONE IN MOLTEN NAPHTHALENE. THE USE OF MIXED ADSORBENTS IN THE CHROMATOGRAPHIC SEPARATION OF ORGANIC COMPOUNDS. CHROMATOGRAPHIC STUDY OF STERIC HINDRANCE IN ORTHO SUBSTITUTED ALKYL PHENOLS

(Publication No. 16,305)

Walter Carling Bradbury, Ph.D.
University of Arkansas, 1956

Supervisor: Jack K. Carlton

THE DETECTION OF BISMUTH WITH DITHIZONE IN MOLTEN NAPHTHALENE

During an investigation of metal ion reactions in non-aqueous media it was found that a solution of dithizone in molten naphthalene reacted with bismuth salts very rapidly to yield a brilliant red color. Bismuth ion concentrations in the range of 0.004 are easily detectable. A spot test procedure is described. Reactions of the dithizone-naphthalene reagent with other metal ions and the nature of the interferences and their masking were studied. Among the most sensitive reactions are: cadmium, 0.02 ; mercury (II), 0.01 ; tin, 0.02 ; and silver, 0.02 . Where these ions are known not to exist in combination, or where separations can conveniently be made, the dithizone-naphthalene reagent may be useful in their detection.

Absorption spectra of the various metal-dithizonates in the molten solvent system were measured with a device designed to replace the conventional cell holder compartment of the Beckman D. U. Spectrophotometer. Employing this modification of the Beckman instrument absorption spectra were obtained for bismuth, tin (II), mercury (II), antimony (III), and cadmium dithizonates and for dithizone in molten naphthalene. The absorption spectra of these metal dithizonates, prepared in molten naphthalene, were recorded and found to be the same as those of the dithizonates obtained by extraction of metal ions from aqueous solution with chloroformdithizone.

THE USE OF MIXED ADSORBENTS IN THE CHROMATOGRAPHIC SEPARATION OF ORGANIC COMPOUNDS

A number of organic compounds representing several different classes have been chromatographed on various binary mixtures of commonly used adsorbents. Two general patterns were found. Adsorption strength was characteristic of one or the other of the two adsorbents in the mixture and was of about the same magnitude as that of the pure adsorbent; the other adsorbent simply acted as a diluent for the active one. Alternatively, a competition was found to exist between the two adsorbents; the resultant adsorption was characteristic of the mixture and varied with percentage of the mixture.

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Mixtures of boron oxide and silicic acid, boron oxide and Florisil, and boron oxide and alumina were found to interact in such a way as to adsorb certain amines more strongly than they were adsorbed by either of the pure adsorbents. This phenomenon was observed with aniline, ethylaniline, and dimethylaniline developed with benzene on columns of the above mixtures. Evidently the acidic nature of one of the two adsorbents is enhanced by the presence of the other. Use can be made of this characteristic to separate aliphatic amines, certain N-substituted and ring substituted aromatic amines.

Those mixed adsorbents which share adsorption of organic molecules, thus exhibiting R_f values intermediate between those measured on the pure adsorbents, should afford the practical chromatographer a wider choice of adsorbents.

CHROMATOGRAPHIC STUDY OF STERIC HINDRANCE IN ORTHO SUBSTITUTED ALKYL PHENOLS

The alkyl substituted phenols have been studied chromatographically to determine the effect of steric hindrance on the adsorption of the ortho isomer. R values of the ortho and para isomers of methylphenol, ethylphenol, isopropylphenol, and tertiarybutylphenol, chromatographed on silicic acid employing benzene as developer, indicate that the o-tert-butyl group is most effective in blocking the approach of the phenol -OH to the adsorbent. The rate of flow of the ortho isomers increases with increasing size of the alkyl group. The para isomers showed a very slight increase as larger alkyl groups were added.

The data obtained in this study substantiate the hypothesis that steric hindrance of the alkyl substituent is the most important influence of that group on the chromatographic adsorption of ortho alkyl substituted phenols. Equally important from the point of view of a practical application, this information affords the chromatographer a simple method for the separation of ortho and para isomers of these alkyl phenols. It can also serve as a simple purification procedure for small quantities of the ortho substituent. 89 pages. $1.11. Mic 56-1671

THE SOLUTION PROPERTIES OF STYRENE-METHACRYLIC ACID COPOLYMERS

(Publication No. 16,048)

Leo Shih-yen Chang, Ph.D.
Polytechnic Institute of Brooklyn, 1956

When hydrogen bonding groups are attached to a high polymer at a relative wide spacing along the chain molecule, both intermolecular and intramolecular group association will occur, so that several experimental techniques will have to be applied simultaneously to describe the consequences of group interaction. In the present investigation, solutions of copolymers of styrene and methacrylic acid in carbon tetrachloride and tetrachloroethane were studied by osmometry, infrared spectroscopy and dilute solution viscosimetry, to determine the effect of the carboxyl content and the molecular weight of the copolymers on the extent of carboxyl dimerization and molecular aggregation. The behavior of the copolymers was interpreted in terms of the dimerization equilibrium of trimethylacetic acid, used as a low molecular weight analog.

The infrared spectra of the dilute copolymer solutions showed that the degree of carboxyl dimerization is independent of the solution concentration. This indicates that an effective carboxyl concentration within the swollen chain molecules determines the dimerization equilibrium. This effective concentration, while independent of the stoichiometric concentration of the solutions below a critical value, at which interpenetration of polymer chains becomes important, depends on the acid content of the copolymer and its extent of swelling in the solvent. The extent of dimerization for each copolymer was calculated from the local concentration of the carboxyls in a swollen polymer coil and the predicted values agree well with those actually found.

Intramolecular association of the carboxyls causes a contraction of the random polymer coil while intermolecular association results in a higher apparent molecular weight.

The extent of both types of association is increased with increasing acid content of the copolymer resulting eventually in phase separation.

Huggins' k', calculated from the slope of the reduced viscosity plots of the copolymers, was found to be strongly dependent on the acid content of the copolymer. It was discussed in terms of hydrodynamic interaction, mutual attraction and double molecule formation.

108 pages. $1.35. Mic 56-1672

CHLORINATION OF HYDROCARBONS AND THE CHEMISTRY OF 1,2,3,3,5,5-HEXACHLORO-4-(DICHLOROMETHYLENE)-CYCLOPENTENE (PARTS I AND II)

(Publication No. 16,460)

Kornelijs Dinbergs, Ph.D.
Purdue University, 1956

Major Professors: Earl T. McBee and
Carleton W. Roberts

PART I

The catalytic two-step chlorination of the following hydrocarbons was investigated: n-heptane, 2,4-dimethylpentane, methylcyclopentane, 2,2,4-trimethylpentane, 3-methylpentane, 2,3-dimethylbutane and pentane. The first step is the liquid-phase chlorination of the hydrocarbon at 95° in the presence of light until about two-thirds of the hydrogen atoms are replaced by chlorine. The second step is the catalytic chlorination of these polychlorocompounds at temperatures ranging from 235-410°. It has been found that the same principal products were obtained from all the hydrocarbons used. The major portion of the product consisted of hexachlorocyclopentadiene, octachlorocyclopentene and 1,2,3,3,5,5-hexachloro-4-(dichloromethylene)-cyclopentene. In addition the reaction gave hexachlorobenzene, hexachlorobutadiene, hexachloroethane, tetrachloroethylene and carbon tetrachloride. The product of most interest is 1,2,3,3,5,5-hexachloro-4-

(dichloromethylene)-cyclopentene. Catalytic chlorination at 250-275° of all the hydrocarbons except the pentanes gave this compound in yields varying from 4.5-37%. The best yield (63%) of 1,2,3,3,5,5-hexachloro-4-(dichloromethylene)-cyclopentene was obtained by the non-catalytic thermal-photochemical chlorination of methylcyclopentane at 205°. The best yields of cyclic, perchloro-5-membered ring compounds were obtained by the catalytic chlorination of pentanes (85%) and methylcyclopentane (70%).

PART II

The positions of the double bonds in 1,2,3,3,5,5-hexachloro-4-(dichloromethylene)-cyclopentene were established by comparing the ultraviolet and infrared absorption spectra of the compound with the spectra of the two monoenes, 1,2,3,3,4,5,5-heptachloro-4-(trichloromethyl)-cyclopentene and perchloromethylenecyclopentane obtained by the addition of chlorine to 1,2,3,3,5,5-hexachloro-4-(dichloromethylene)-cyclopentene. The results indicate that the double bonds in 1,2,3,3,5,5-hexachloro-4-(dichloromethylene)-cyclopentene are not conjugated.

The reaction of 1,2,3,3,5,5-hexachloro-4-(dichloromethylene)-cyclopentene with methanolic potassium hydroxide gave two methoxy compounds whose structures could not be established. Acid hydrolysis of both methoxy compounds gave 4,5-dichlorocyclopentene-1,3-dione. 4,5-Dichlorocyclopentene-1,3-dione can be obtained also by hydrolyzing 4,5-dichloro-2-(dichloromethylene)-cyclopentene-1,3-dione with 95% ethanol. The chlorination and bromination products of 4,5-dichlorocyclopentene-1,3-dione were prepared and the correct melting point for 2,2,4,5-tetrachlorocyclopentene-1,3-dione established.

The bromination of 1,2,3,3,5,5-hexachloro-4-(dichloromethylene)-cyclopentene with anhydrous aluminum bromide gave 1-chloro-2,3,3,5,5-pentabromo-4-(dibromomethylene)-cyclopentene,1,2-dichloro-3,3,5,5-tetrabromo-4-(dibromomethylene)-cyclopentene and 1,2-dichloro-3,3,5,5-tetrabromo-4-(dichloromethylene)-cyclopentene. The structures of these bromochlorocompounds were established by the oxidation to 4,5-dihalo-2-(dihalomethylene)-cyclopentene-1,3-diones and their subsequent cleavage to 4,5-dihalocyclopentene-1,3-diones. The ultraviolet and infrared absorption spectra of the bromochlorocompounds are presented.

Catalytic hydrogenation or the reduction of 1,2,3,3,5,5-hexachloro-4-(dichloromethylene)-cyclopentene with a zinc-copper couple in hydrochloric acid resulted in perchlorofulvene. If the reduction was carried out with zinc and ethanol a fulvene, m.p. 127-128°, was obtained. Based on spectral data, chemical reactivity and derivatives, four alternate structures are proposed for the fulvene, m.p. 127-128°.

209 pages. $2.61. Mic 56-1673

THE SYNTHESIS OF 1-METHYL-3,4-BENZPYRENE, 8-METHYL-3,4-BENZPYRENE, AND 1,8-DIMETHYL-3,4-BENZPYRENE

(Publication No. 16,648)

William Carter Doyle, Jr., Ph.D.
The University of New Mexico, 1956

Chairman: Associate Professor Guido Herman Daub

Anthrone condensed with acrylonitrile in the presence of potassium t-butoxide and the intermediate nitrile was hydrolyzed and reduced to give β-(9-anthranyl)-propionic acid. Further reduction and cyclization with anhydrous hydrogen fluoride yielded 3-keto-1,2,3,11b-tetrahydro-7H-mesobenzanthracene. This was converted via the Stobbe condensation to β-(1,11b-dihydro-7H-mesobenzanthracene-3)-propionic acid which was converted by reduction and cyclization to 8-keto-1,2,2a,5,8,9,10,10a-octahydro-3,4-benzpyrene. Reaction of this ketone with methylmagnesium iodide followed by dehydration and dehydrogenation afforded 8-methyl-3,4-benzpyrene in 12% over-all yield from anthrone. Biological testing of this hydrocarbon shows it to be almost as potent a carcinogen as 3,4-benzpyrene itself.

Following the condensation of anthrone with ethyl methacrylate, a similar series of reactions led to 8-keto-1-methyl-1,2,2a,5,8,9,10,10a-octahydro-3,4-benzpyrene. This was converted by a Wolff-Kishner reduction followed by dehydrogenation to 1-methyl-3,4-benzpyrene and by a Grignard reaction and dehydration and dehydrogenation to 1,8-dimethyl-3,4-benzpyrene. The over-all yield of each of these compounds from anthrone was 9%.

The three hydrocarbons all have the intensely colored picrates characteristic of carcinogenic hydrocarbons.

90 pages. $1.13. Mic 56-1674

A STUDY OF D-GLUCOSE POLYMERIZATION

(Publication No. 16,506)

Harry W. Durand, Ph.D.
University of Pittsburgh, 1956

The chemistry of the acid-catalyzed polymerization of simple reducing sugars is presently poorly understood. As a contribution to a better knowledge of the reaction, the self-condensation of α-D-glucose on heating its dry mixture with metaboric acid was investigated, using a standard blend of 100 parts of the crystalline anhydrous sugar (at 50-60 mesh) with five parts of the powdered metaboric acid (at 200 mesh or finer). An ordinary electrically-heated air-circulating oven was found to serve satisfactorily as the heat source.

The general course and duplicability of the reaction at 140° C. was defined in terms of decrease of reducing-sugar content and loss of weight. The information thereby obtained was used to prepare crude polymeric products, which were shown to give an amorphous x-ray diffraction pattern while still retaining the crystal size and shape of the original sugar.

The crude polymers were refined by exhaustive extraction with cold anhydrous methanol (using both multiple

and continuous techniques), and in one instance by use of methanol as a fractionating solvent, to give products evidently free of monomeric entities and from which 97-99 per cent of the original metaboric acid had been removed.

The polymers so refined were characterized as to molecular weight, specific rotation, viscosity, infrared absorption, hydroxyl content, and rate of acid hydrolysis. The results showed the polymers to be heterogeneous in molecular size and structure and to be built up of many (at least six to 17, based on cryoscopic data) anhydro-D-glucopyranose units largely terminating in a D-glucosan residue.

One of the refined polymers, having a degree of polymerization (D. P.) of 5.7 according to cryoscopic measurement, was examined by qualitative paper chromatographic procedure. The evident lack of migration of the unhydrolyzed polymer showed it to consist largely of material of D. P. greater than nine. The fact that only D-glucose was detected chromatographically after complete acid hydrolysis indicated the polymer to be built simply of poly-D-glucosidic bonds. Partial acid hydrolysis revealed only the 6—→1 acetal bond as a structural mode, without anomeric differentiation. However, paper chromatography of the acid hydrolyzate of the fully methylated polymer gave evidence of a highly branched structure (rather than cyclic) containing both 6—→1 and 4—→1 acetal linkages.

109 pages. $1.36. Mic 56-1675

THE PREPARATION AND GEOMETRY OF o,o′-BRIDGED BIPHENYLS AND DIPHENYLMETHANES CONTAINING SULFUR OR SELENIUM IN THE BRIDGE

(Publication No. 16,461)

Donald Day Emrick, Ph.D.
Purdue University, 1956

Major Professor: William E. Truce

This study involves the preparation of a number of 2,7-dihydro-3,4-5,6-dibenzoheteropins (heterodibenzo-[a,c]cycloheptadienes) in which the hetero group is larger than carbon in size and is represented by a sulfide, sulfone, methyl sulfonium, methyl selenonium, dimethyl selenonium, or selenide grouping located between o,o′ methylene groups of the bridged biphenyl. Since the hetero group is removed from ready resonance interaction with the benzene rings of the o,o′-bridged biphenyl by means of the methylene groups, the degree of non-coplanarity and consequent asymmetry of the biphenyl may be estimated from ultraviolet absorption spectra. With the exception of 2,7-dihydro-1-methyl-3,4-5,6-dibenzothiapinium iodide (maximum at 249 mμ), all the hetero groups of this study showed absorption maxima at significantly shorter wave length (indicative of enhanced non-coplanarity of the biphenyl system) than the previously reported dibenzo[a,c]-[3,5]cycloheptadiene-1,1′-dicarboxylic acid (249 mμ) and dibenzo[a,c][3,5]cycloheptadiene-1-carboxylic acid (249 mμ) which could not be resolved.[1] Thus, while coplanar crystalline biphenyl has a maximum at 275 mμ[2] and 2,7-dihydro-3,4-5,6-dibenzoxepin (hetero group oxygen) a maximum at 250 mμ,[3] compounds of this study showed the following absorption maxima: 2,7-dihydro-3,4-5,6-dibenzothiapin, 245 mμ; 2,7-dihydro-3,4-5,6-dibenzoselenopin, 247 mμ; 2,7-dihydro-3,4-5,6-dibenzothiapin-1-dioxide, 243 mμ; and 2,7-dihydro-1-methyl-3,4-5,6-dibenzoselenopinium iodide, 218 mμ. The cyclic sulfide and selenide were prepared by cyclization of 2,2′-bis(bromomethyl)biphenyl with sodium sulfide or potassium selenide in methanol. The onium salts were obtained by the alkylation of the cyclic sulfide or selenide with methyl iodide. Dinitration of 2,7-dihydro-3,4-5,6-dibenzothiapin-1-dioxide produced mainly 2,7-dihydro-2′,3″-dinitro-3,4-5,6-dibenzothiapin-1-dioxide paralleling the dinitration of biphenyl and fluorene in p,p′- and 2,7-positions, respectively.

As both 2,7-dihydro-4′,1″-dimethyl-3,4-5,6-dibenzoxepin and 1,1-dimethyl-2,7-dihydro-4′,1″-dimethyl-3,4-5,6-dibenzoazepinium bromide have absorption maxima at 242 mμ and have been obtained in optically active form,[4] it was felt that 2,7-dihydro-3,4-5,6-dibenzothiapin-1-dioxide and 2,7-dihydro-1-methyl-3,4-5,6-dibenzoselenopinium ion should exhibit stable enantiomorphism.

2,7-Dihydro-3,4-5,6-dibenzothiapin-1-dioxide-2′,3″-dicarboxylic acid (I), with carboxylic acid "handles" for purposes of resolution, was prepared as follows. Dimethyl 4,4′-dibromodiphenate was reduced with lithium aluminum hydride, to 2,2′-bis(hydroxymethyl)-4,4′-dibromobiphenyl. Conversion of this to 2,2′-bis(bromomethyl)-4,4′-dibromobiphenyl with excess refluxing hydrobromic acid and cyclization of the dibromide with methanolic sodium sulfide produced 2′,3″-dibromo-2,7-dihydro-3,4-5,6-dibenzothiapin. Oxidation of the latter with hydrogen peroxide in acetic acid produced 2′,3″-dibromo-2,7-dihydro-3,4-5,6-dibenzothiapin-1-dioxide. Replacement of the bromo with cyano groups by means of cuprous cyanide in quinoline gave 2′,3″-dicyano-2,7-dihydro-3,4-5,6-dibenzothiapin-1-dioxide which upon acid hydrolysis produced in fair over-all yield the desired dicarboxylic acid. Partial resolution of this acid was accomplished with the neutral brucine salt while more conclusive resolution was obtained with the cinchonine hydrogen salt. Although no levorotatory antipode could be obtained, the more dextrorotatory cinchonine hydrogen salt fraction produced an acid having $[\alpha]_D^{27}$ + 3.1°, as the ammonium salt. Although some evidence of diastereomerism was observed with the d-camphorsulfonate, the hydrogen d-tartrate salt of 2,7-dihydro-1-methyl-3,4-5,6-dibenzoselenopinium ion showed more distinct evidence of diastereomerism. However, recovered selenonium iodide was inactive and recovered selenonium chloroplatinate from the diastereomeric hydrogen d-tartrates was inconclusively slightly active. As expected, no evidence for diastereomerism was observed with the neutral d-tartrate, hydrogen d-tartrate, or d-camphorsulfonate salts of 2,7-dihydro-1-methyl-3,4-5,6-dibenzothiapinium ion. The ammonium salt of 2,7-dihydro-3,4-5,6-dibenzothiapin-1-dioxide-2′,3″-dicarboxylic acid represents the first case of demonstrable optical activity in a seven-membered ring, 2,2′-bridged biphenyl not having auxilliary ortho hindering groups in the 6,6′-positions.

2′-Methylsulfonylbiphenyl-2-carboxylic acid was prepared in 12 percent yield via a mixed Ullmann reaction. Dieckmann cyclization of the ethyl ester of the latter with sodium produced 6,7-dihydro-2,3-4,5-dibenzothiapin-6-one-1-dioxide (II) in good yield. Several multi-membered ring 2,2′-bridged diphenylmethanes, e.g. III, analogous to

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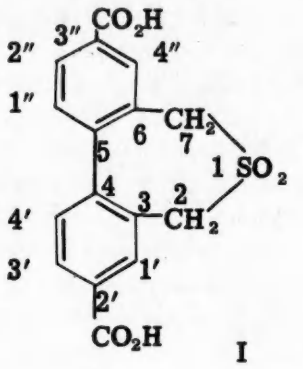
the compounds described in the biphenyl series, have been prepared by similar procedures.



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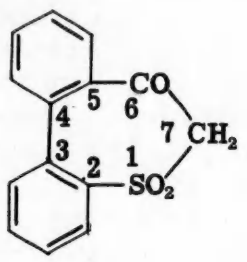

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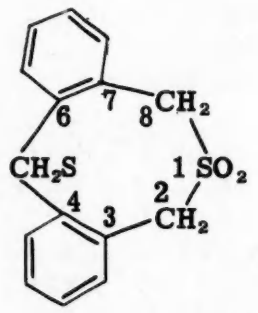

III

BIBLIOGRAPHY

1. F. Bell, J. Chem. Soc., 1952, 1527-8.
2. H. Gilman and A. H. Blatt, "Organic Synthesis," Coll. Vol. 1, Second Ed., John Wiley and Sons, New York, 1951, p. 514.
3. G. H. Beaven, et. al., J. Chem. Soc., 1952, 854-868.
4. G. Wittig and H. Zimmerman, Ber., 86, 629 (1953).

278 pages. $3.48. Mic 56-1676

METHYL-1,3,5-HEXATRIENES

(Publication No. 16,635)

Herman Fleischacker, Ph.D.
University of Maryland, 1956

Supervisor: Professor G. Forrest Woods

Preparation of the methyl-1,3,5-hexatrienes which may be considered as the open-chain analogs of toluene, and the study of their physical and chemical properties, were the purposes of this investigation.

2,4-Heptadien-6-ol was obtained by the reaction of methylmagnesium bromide with 2,4-hexadienal. The dienol was dehydrated catalytically with alumina at 350° to yield 1,3,5-heptatriene.

Addition of maleic anhydride to 1,3,5-heptatriene provided 3-propenyl-1,2,3,6-tetrahydrophthalic anhydride and 3-vinyl-6-methyl-1,2,3,6-tetrahydrophthalic anhydride as demonstrated by aromatization and oxidation to yield 1,2,3-benzenetricarboxylic acid as well as 1,2,3,4-benzenetetracarboxylic acid. The factors influencing the mode of addition were not explored.

Dehydration of 2,4-heptadien-6-ol at 500° or distillation of the triene in the vapor phase through a column containing alumina yielded methylcyclohexadiene, which was aromatized to toluene. This was identified by oxidation to benzoic acid. The location of the double bonds in our methylcyclohexadiene is not known. The maleic anhydride adduct of methylcyclohexadiene absorbed one mole of hydrogen on mild hydrogenation with 10% palladium on charcoal, while the respective adduct of 1,3,5-heptatriene absorbed two moles of hydrogen under similar conditions.

The reaction of allylmagnesium bromide with methyl vinyl ketone provided 3-methyl-1,5-hexadien-3-ol, which was dehydrated with phosphorus pentoxide to yield 3-methyl-1,3,5-hexatriene. Dehydration of the dienol with alumina at 500° led to methylcyclohexadiene; the position of unsaturation in this compound is not known. The maleic anhydride adduct of 3-methyl-1,3,5-hexatriene absorbed two moles of hydrogen on hydrogenation with palladium on charcoal at atmospheric pressure and room temperature; the respective adduct of methylcyclohexadiene absorbed one mole of hydrogen under similar conditions. Methylcyclohexadiene was aromatized and the product oxidized to benzoic acid.

Methacrolein reacted with allylmagnesium bromide and 2-methyl-1,5-hexadien-3-ol was obtained. Dehydration of the dienol with phosphorus pentoxide yielded 2-methyl-1,3,5-hexatriene. Dehydration of the dienol with alumina at 500° yielded methylcyclohexadiene. The maleic anhydride adduct of 2-methyl-1,3,5-hexatriene absorbed two moles of hydrogen on mild hydrogenation with palladium charcoal; the respective adduct of methylcyclohexadiene absorbed one mole of hydrogen under similar conditions. Aromatization of methylcyclohexadiene and oxidation of the product yielded benzoic acid.

Ultraviolet absorption spectra of the methyl-1,3,5-hexatrienes exhibit three well defined characteristic absorption maxima, which is in agreement with the ultraviolet spectra of other trienes. The methylcyclohexadienes exhibited ultraviolet spectra typical of conjugated dienes; namely largely devoid of fine structure with essentially one broad maximum. 146 pages. $1.83. Mic 56-1677

A THERMODYNAMIC STUDY OF SILVER ION COMPLEXES WITH POLYNUCLEAR HYDROCARBONS

(Publication No. 16,512)

George Conrad Harrison, Jr., Ph.D.
University of Pittsburgh, 1956

The primary aim of this work was to make an exact thermodynamic study of silver ion – polynuclear hydrocarbon interactions as a means of providing an experimental test of the Pullman hypothesis relating electron density and carcinogenicity of a polynuclear hydrocarbon.

Inasmuch as measurements in salt solutions of high ionic strength were required in the study, it was necessary to consider the determination and application of activity corrections neglected in earlier studies.

Further, an attempt to extend the study to ethanol-water solvent mixtures was made in order to enable the extension of the measurements to include those hydrocarbons not sufficiently soluble in aqueous media and, also, to permit the use of solutions of lower ionic strength.

The solubility of the aromatic hydrocarbons in salt solutions and in water was measured spectrophotometrically.

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Approximately 0.1 to 0.5 grams of the hydrocarbon was shaken at a constant temperature for 15 to 24 hours. Measured quantities (either by volume or by weight) of the aqueous phase were separated and analyzed for the hydrocarbon content with a Beckman model D.U. Quartz Spectrophotometer. From these solubility data, argentation constants were calculated.

The solubility of cyclohexane in salt solutions and in water was determined by a microcombustion technique. The cyclohexane was volatilized by bubbling oxygen gas through an aqueous sample of known volume. This vapor was burned to carbon dioxide in a combustion furnace containing CuO at 700-800°C. The carbon dioxide formed was collected and weighed in an Ascarite–filled absorption tube. From the weight of carbon dioxide collected, the concentration of cyclohexane was calculated.

Since concentrated solutions were required in this study, only a qualitative discussion of the data was possible. It was shown that the interactions of silver ion with the aromatic hydrocarbons was very largely dependent upon structural entropy. There seemed to be an electronic dependent effect superimposed upon this important entropy effect. The suggestion was made that the electronic part was responsible to the specificity of the reaction with silver ion in preference to the other ions present. It was possible to partially separate these two factors, and thus a correlation of argentation with electron density was made.

Approximate salting and activity corrections were added to make the argentation constants more nearly true thermodynamic equilibrium constants. In general, it must be concluded that these interactions are much more complicated than previous investigators have implied in their simplified interpretations.

Preliminary studies on argentation in aqueous silver ion solutions containing 10, 20, and 30 per cent by weight of ethanol showed that such solutions may be useful for studying the argentation interactions at ionic strengths lower than 0.200. It should also be possible to study in these mixed solvent solutions, compounds of large size, such as chrysene, which are too insoluble to be studied in the completely aqueous system.

An experimental technique is proposed for the investigation of solvates of ions. This procedure is demonstrated by calculations, from data in the mixed solvent system, of the number of molecules of ethanol apparently coordinated with a silver ion. 107 pages. $1.34. Mic 56-1678

MECHANISM OF REDUCTION OF ACID HALIDES BY GRIGNARD REAGENTS

(Publication No. 16,772)

Anthony Koroscil, Ph.D.
New York University, 1956

Adviser: Professor Robert T. Morrison

The effect of various Lewis acids, including heavy metal halides in trace amounts, on the reaction between trimethylacetyl chloride and tert-butylmagnesium chloride has been studied. Certain Lewis acids were found to increase the yield of addition product at the expense of reduction.

These results, as well as the previously reported effect of order of mixing of reagents and effect of traces of cuprous chloride, are consistent with mechanisms proposed for (a) reduction of acid halides by Grignard reagents, (b) addition of Grignard reagents to acid halides, and (c) catalysis of Grignard reactions by traces of metal halides.

Magnesium bromide was found to have no effect on the reaction between trimethylacetaldehyde and tert-butylmagnesium chloride.

The effect of varying the proportions of reagents on the reaction between mesitoyl chloride and methylmagnesium iodide in the presence of boron trifluoride was studied. The results confirm a previously proposed mechanism for inhibition of Grignard reactions by large amounts of Lewis acids. 108 pages. $1.35. Mic 56-1679

A STUDY OF THE MECHANISM OF THE DISPLACEMENT REACTION OF ALKYL AND PHENACYL CHLORIDES WITH IODIDE ION

(Publication No. 16,642)

Edward Lawrence Mc Caffery, Jr., Ph.D.
University of Maryland, 1955

Supervisor: Professor E. Wilkins Reeve

The rate of the reactions of normal, secondary, and tertiary butyl chlorides, isobutyl chloride, phenacyl chloride, α-chloropropiophenone and α-chloroisobutyrophenone with sodium iodide in anhydrous acetone was studied at 0°C. and 50°C. in an attempt to determine the relative importance of steric hindrance in a second order displacement reaction. The course of the reaction was followed by measuring the amount of iodide ion remaining at any time by electrometric titration using silver nitrate as a titrant.

The displacement reaction was the primary reaction in the cases studied but the kinetic measurements became increasingly more complicated with the branching at the alpha carbon atom. The deviation from the normal reaction was evidenced by the appearance of free iodine in the acetone solution. The side reaction proved to be an elimination resulting in an olefinic product.

The experimental results led to the following conclusions. Isobutyl chloride is less reactive than its primary counterpart, n-butyl chloride, because of the steric retardation caused by the interaction between the entering and leaving halogen atoms with the beta methyl group. sec-Butyl chloride is less reactive than n-butyl because the presence of two alkyl groups at the reaction center creates a greater steric barrier to the approaching neucleophilic group. tert-Butyl chloride is about as reactive as sec-butyl chloride. This effect is explained by stating that the addition of an additional methyl group in the alpha position forces the molecule from its tetrahedral structure, thus making it more susceptible to attack.

Phenacyl chloride is about 23,000 times as reactive as n-butyl chloride at 50°c. This is believed to be due to the presence in the molecule of a strong positive center at the carbonyl carbon atom which attracts the negative iodide ion to the most favorable position in the molecule for

reaction. α-Chloropropiophenone is less reactive than phenacyl chloride because, as in the case of sec-butyl chloride, the addition of a methyl group at the reaction center causes increased steric hindrance. α-Chloroisobutyrophenone is much less reactive than its secondary counterpart because the strong electron attracting power of the carbonyl group keeps the chlorine atom close to the reaction center and holds the central carbon atom in its tetrahedral form, thus markedly increasing the steric inhibition of the attached groups. It is therefore concluded that steric effects and not inductive effects determine the rate of addition in second order displacement reactions of this type.

Phenol was added to the reaction mixtures at a concentration equal to that of the organic chlorides and iodide ion; it was found to have no effect upon the reaction rate. The reaction was first order in each component, except phenol; therefore not termolecular since phenol would exhibit a much greater pulling force than acetone.

104 pages. $1.30. Mic 56-1680

STUDIES OF THE MECHANISM OF THE CYCLIZATION REACTION IN THE SYNTHESIS OF OCTAHYDROPHENANTHRENES

(Publication No. 16,686)

Arthur David Olin, Ph.D.
Rutgers University, 1956

The stereospecificity of the Bardhan-Sengupta and Bogert-Cook cyclizations in the synthesis of octahydrophenanthrenes has been previously demonstrated. Elucidation of the exact mechanism involved could be brought about, it was believed, by the use of an optically active cyclizable intermediate.

In this connection two different approaches to the synthesis of the directly resolvable 2-methyl-2 β-phenylethylcyclohexylamine were examined. One concerned the preparation of an intermediate amide through a tertiary carboxylic acid and the other utilized the Haller method for the direct synthesis of a tertiary carboxamide. Neither approach gave the expected results.

A suitable intermediate for this study was found in optically active trans 2 β-phenylethylcyclohexanol. This alcohol was prepared in the following manner. Cyclohexene oxide was alkylated with lithium phenylacetylene to yield trans 2 β-phenylethinylcyclohexanol. This solid was resolved through its acid phthalate derivative with d-α-phenylethylamine. The resolved alcohol m.p. 49-53°, $[\alpha]_D$ = -56.3 c = 1 in chloroform, was then catalytically hydrogenated to give the desired product, 1 trans 2-β-phenylethylcyclohexanol, m.p. 65° $[\alpha]_D$ = -55, c = 1 in chloroform.

Cyclization of this material in sulfuric acid produced a mixture of hydrocarbons which were identified by oxidation with chromic acid to their ketonic derivatives. These were isolated by oximating with hydroxylamine and chromatographing the resultant mixture. A high proportion of optically active cis octahydrophenanthrene oxime having a positive sign of rotation was found.

The positive rotation of this isomer indicates that the optical activity of the product is due to a non-planar intermediate and the activity is real and not the result of contamination with optically active starting material. An olefin intermediate is thus ruled out. These results may be construed as arising from a mechanism involving a concerted nucleophilic aromatic alkylation.

In the chromic acid oxidation of the cyclized material a ketone of unknown structure, which may be presumed to arise from octahydrophenanthrene, was isolated and partially characterized as its oxime derivative. Comparison of the U. V. spectra of the octahydrophenanthrene ketoxime and the unknown ketoxime show a bathochromic shift for the latter consistent with an extra conjugated double bond. On the basis of this and other information, several structures of the hexahydrobenzazulone type are proposed for this material.

86 pages. $1.08. Mic 56-1681

SELECTIVE REDUCTIONS USING COMPLEX HYDRIDES

(Publication No. 16,495)

Bookinkere C. Subba Rao, Ph.D.
Purdue University, 1956

Major Professor: Herbert C. Brown

Dimethyl ether of diethylene glycol (diglyme) was found to be a convenient solvent for sodium borohydride. High purity sodium borohydride (99.6 to 99.9%) may be obtained readily by recrystallization from this solvent. Reductions of ketones in this solvent are slow but are catalyzed by alcohol, water and especially triethylamine. Esters are not reduced by sodium borohydride in this solvent. However, the reduction of esters can be brought about by the addition of lithium bromide or anhydrous magnesium chloride to sodium borohydride in diglyme. Sodium borohydride-lithium bromide in diglyme reduces only the ester group and has no action on nitro group and olefinic linkage, while sodium borohydride-magnesium chloride reduces ester group, attacks double bonds in esters but has no action on the nitro group at moderate reaction temperatures.

Reduction of esters to corresponding alcohols in high yields (80 to 90%) has been accomplished using sodium borohydride and anhydrous aluminum chloride in diglyme. The reaction is also catalyzed by other polyvalent metal halides, such as gallium trichloride, titanium tetrachloride, etc. The new reagent (3 $NaBH_4$ + $AlCl_3$ in diglyme) is safe to handle and also selective in that the nitro groups are unaffected in the process of reduction. Nitro alcohols have been obtained in good yields from nitro esters and nitro acids.

The observation that no precipitate of sodium chloride is obtained on mixing aluminum chloride and sodium borohydride is interpreted to mean that no more than trace amounts of aluminum borohydride is present in the reaction medium. It may be that reduction proceeds through this small quantity of the reagent, with more being formed as it is utilized in reductions.

The reagent is capable of reducing several other functional groups other than esters. Thus free carboxylic acids are reduced to the corresponding alcohols, but the sodium salts of the acids are unaffected. The nitriles are reduced to amines in good yields. Unsubstituted acid amides form

only salts with the reagent, while disubstituted amides undergo reduction. Epoxides are reduced to alcohols; lactones are reduced to glycols; aldehydes, ketones and acid chlorides are all vigorously reduced to alcohols, while alcohols form alkoxy derivatives. Alkyl halides are unaffected at 25°, but are slowly reduced at 75°. Disulphides and sulphonyl chlorides are reduced to thiols, while sulphones are unaffected. Pyridine-N-oxide is reduced to pyridine, although pyridine itself is not affected by the reagent at 25°. The reagent does not appear to attack aromatic nuclei such as that in naphathalene.

1- and 2-olefins have been found to react differently with the reagent (3 $NaBH_4$ + $AlCl_3$ in diglyme). 2-olefins are not attacked while 1-olefins are reacted with. It is possible to separate 2-olefins from a mixture of 1- and 2-olefins. This reagent reacts with ethylene to form borontrialkyls.

Attempts were made to reduce acid chlorides to aldehydes by sodium borohydride in diglyme and in the presence of a tertiary amine. Efforts were made to improve the yield of aldehyde by a wide variation of reaction conditions, such as temperature, time, presence of base and the ratio of acid chloride to sodium borohydride. The yield was no better than 35%. Use of acid bromide in place of acid chloride resulted in no improvement. Low yields were found to be due to concurrent reduction of aldehyde to alcohol.

Conditions were established for the formation of trialkoxy-and dialkoxyborohydride from sodium borohydride and aldehydes. Use of substituted borohydrides resulted only in slight improvement in yield (40-43%) of aldehyde formed.

283 pages. $3.54. Mic 56-1682

THE REACTIONS OF ALKYL IODIDES WITH HALOGENS

(Publication No. 8941)

Herman S. Schultz, Ph.D.
Polytechnic Institute of Brooklyn, 1956

Supervisor: Professor F. M. Beringer

It was felt that useful information might be obtained concerning the non-radical path available for exchange of halogens with the iodine in alkyl iodides by studying the reactions of chlorine, bromine, and iodine monochloride with optically active 2-iodooctane and with neopentyl iodide, a compound capable of forming a hydrocarbon radical susceptible to carbonium ion rearrangement.

Optically active 2-iodooctane reacted with chlorine and with bromine in a cold inert solvent and with bromine in an inert solvent at 25° to give as product 2-chlorooctane and 2-bromooctane of predominantly inverted configuration. A similar reaction with iodine monochloride at 25° yielded 2-chlorooctane of predominantly inverted configuration, optically inactive 2,3-dichlorooctane and an optically inactive iodochlorooctane. The order of degree of inversion of configuration in the reactions of optically active 2-iodooctane are Cl_2 at -78° > Br_2 at -78° > Br_2 at 25° > ICl at 25°. Neopentyl iodide reacted with chlorine and bromine in a cold inert solvent to give tert-amyl halides and the halogen adducts of trimethylethylene. tert-Amyl chloride reacted with chlorine and an equivalent amount of iodine monochloride to form trimethylethylene dichloride.

The identity and isomeric purity of the products and of 2-iodooctane were shown by derivatives, characteristic reactions and the comparison of infrared spectra with those of reference compounds. The displacement was shown to occur without any appreciable formation of position isomers during the formation of the optically active 2-chloro- and 2-bromooctanes.

Possible mechanisms for these reactions have been discussed in the light of the work reported here and in the literature. The specific rotation data was interpolated to give K_i/K_r, the ratio of the rate of the reaction of inversion to the rate of the reaction with retention of configuration, and K_{in}/K_{rac}, the ratio of the rate of the inversion reaction to the rate of the reaction with racemization, assuming no retention reaction. Some possible mechanisms may be summarized as for the reaction of 2-iodooctane with iodine monochloride. An intermediate iodosoiodochloride may first form. The formation of dihalogenooctanes might occur by the ionization of the 2-octyliodosoiodochloride to the 2-octyl cation and the iodochloroiodate (I) anion followed by abstraction of a C_3- hydrogen by the anion to give 2-octene, hydrogen chloride and iodine according to the Saytzeff rule. Iodine monochloride might then add to the olefin. Further reaction of the iodochloride with iodine monochloride would yield 2,3-dichlorooctane. There is also the possibility of nucleophilic attack by a halogen molecule on the same ion pair to give 2-chlorooctane with either inversion of configuration or racemization. An alternate possibility would be a nucleophilic attack on the unionized complex by a halogen molecule leading to 2-chlorooctane of inverted configuration.

82 pages. $1.03. Mic 56-1683

DERIVATIVES OF IMINODIACETIC ACID

(Publication No. 14,632)

Alvin Stein, Ph.D.
Polytechnic Institute of Brooklyn, 1956

The interesting chelating properties of aminopolycarboxylic acids prompted this study of derivatives of iminodiacetic acid. Several alkyl, aryl, and barbituryl derivatives of iminodiacetic acid were prepared, and their titration behavior was investigated in the presence and absence of metal ions.

Alkylation of aliphatic and aromatic amines with chloroacetic acid in alkaline solution gave substituted iminodiacetic acids which were purified by precipitation of their barium salts followed by decomposition with sulfuric acid or by fractional crystallization from water or aqueous alcohol. The alkyliminodiacetic acids, and their metal chelates, were insoluble in most organic solvents. The surface tension of aqueous alkaline solutions of these acids was measured at various concentrations, yielding surface tension-composition curves typical of surface active agents.

Alkylation of o-aminophenol with chloroacetic acid afforded a compound which was shown to be a labile lactone of o-hydroxyphenyliminodiacetic acid. This compound showed very weak complexing with lithium ion.

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Condensation of substituted ureas with malonic acid using acetic anhydride in acetic acid gave poor yields of 1-substituted barbituric acids accompanied by troublesome quantities of 5-acetylbarbituric acids. An improved method consisted of condensing substituted ureas with malonic ester using sodium ethylate in alcohol.

The barbituric acids were converted to 5-aminobarbituric acids (uramils) by nitrosation with sodium nitrite followed by reduction with ammoniacal sodium hydrosulfite. Alternatively, some uramils were made by condensing acetamidomalonic ester or ethyl phthalimidomalonate with ureas via the sodium ethylate in alcohol procedure. The former aminomalonic ester derivative gave 7-acetyluramils which were hydrolyzed to uramils by refluxing with hydrochloric acid; the latter reagent gave the free uramil directly, hydrolysis occurring during the condensation step.

Uramil 7,7-diacetic acids were prepared by alkylating uramils with chloroacetic acid. The crude products of the reaction were extensively contaminated with inorganic salts which could not be removed by numerous recrystallizations from water. Passage of the crude products through a cation exchange column gave pure compounds. The 1-substituted uramildiacetic acids chelated noticeably with lithium ion above pH 6.

The results of this study suggest that the enolic hydroxyl groups of the barbituric acid residue of uramildiacetic acid do not participate in the chelation process with alkali metal ions. This confirms the assumption that electrostatic effects operating through the barbituric acid ring are responsible for the special chelating ability of uramildiacetic acid.

The remarkably poor solubility of the iminodiacetic acid derivatives in a wide range of solvents indicates the dipole moment to be abnormally high in these compounds. This class of compounds, having a strong complexing polar group at the head of a long hydrocarbon chain, showed promise as corrosion inhibitors and ore flotation agents; a new investigation has been initiated aimed toward the measurement and elucidation of the properties of such amphipatic agents. 144 pages. $1.80. Mic 56-1684

CHEMISTRY, PHYSICAL

ABSOLUTE RATE CONSTANTS IN THE ADDITION OF BROMOTRICHLOROMETHANE TO OCTENE-1

(Publication No. 14,631)

Seymour Aronson, Ph.D.
Polytechnic Institute of Brooklyn, 1956

Kharasch and co-workers at the University of Chicago, in 1947, initiated an interesting and informative study of the addition of compounds to the olefinic double bond. They showed that bromotrichloromethane and other compounds could be added quantitatively to olefinic double bonds to yield the "anti-Markownikoff" addition products. Initiation was produced by means of light or radical producing initiators. The reaction was explained on the basis of a free radical chain mechanism.

The details of the mechanism involved in these reactions were further elucidated by the work of Alfrey and Livingston at the Polytechnic Institute of Brooklyn. They studied the kinetics of the addition of bromotrichloromethane to octene-1 in benzene solution using the compound, azo-bis-isobutyronitrile (AIBN) as the initiator. The results of their studies indicated that the dependence of the rates of the addition reaction on the concentrations of octene and bromotrichloromethane were determined by the ratio of these two concentrations in solution. They derived rate equations covering the whole range of concentration ratios, and they determined the overall rate constants for the reaction.

The photochemically initiated addition of bromotrichloromethane was recently studied in detail by Melville and co-workers in England. They applied the rotating sector technique of photochemistry to the addition of the halomethane to cyclohexene and vinyl acetate. On the basis of their experimental data, they proposed a reaction mechanism similar to that proposed by Livingston. By the use of the rotating sector, they obtained values for the rate constants of the elementary steps of propagation and termination.

In the work discussed here, the kinetics of the addition of bromotrichloromethane to octene-1 were studied at a high ratio of bromotrichloromethane to octene-1, and values were obtained for the rate constants of propagation and termination. The initiation of the reaction was effected by photochemical means and by use of the catalysts AIBN and 1-azo-cyclohexane-carbonitrile. A dilatometric method was employed to follow the reaction rates.

Utilization of the rotating sector technique made possible the determination of the average lifetime of the trichloromethyl radical formed as an intermediate. α ,α-Diphenyl-β-picrylhydrazl and iodine, both highly colored free radical scavengers, were used to obtain rates of catalytic initiation. Two methods were employed, inhibition time studies and catalyst decomposition rate studies. These studies yielded satisfactory results with AIBN. The results obtained with the cyclic catalyst were less satisfactory.

The average radical lifetime together with the measurements of the rate of initiation permitted estimation of the absolute values of the rate constants for propagation and termination.

The average radical lifetime was found to be 1.7 seconds under the experimental conditions employed. The values obtained for the rate constants of propagation and termination are $4.7 \times 10_3$ and $5.0 \times 10_7$ liters/mole-sec. respectively.

The value obtained for the termination rate constant agrees with the value obtained by Melville for the same reaction step. The value obtained for the propagation rate constant indicates that octene is ten times more reactive towards trichloromethyl radical than is cyclohexene. The difference in reactivity between these two structurally similar compounds may be explicable on the basis of resonance considerations or of steric hindrance.

110 pages. $1.38. Mic 56-1685

THE VISCOSITY OF LIQUIDS

(Publication No. 14,446)

Werner Wilfried Brandt, Ph.D.
Polytechnic Institute of Brooklyn, 1956

The theories of liquid viscosity presented up to date are either too complicated to be of practical use or they are of questionable validity. It is therefore desirable to find workable methods of calculating the viscosity based on sound assumptions.

This work consists of three distinct parts. First it was undertaken to compare experimental viscosities with the contribution to the viscosity due to the collisional transport of momentum in a liquid, η_c, which can be calculated from a theory given by Collins and Raffel

$$\eta_c = \frac{2}{5\sqrt{\pi}} \frac{\sigma^2 (mkT)^{1/2}}{v(1 - (v_0/v)^{1/3})}$$

Here σ is the molecular diameter, m the molecular mass, v the molecular volume, v_0 the incompressible volume per molecule, k the Boltzmann constant and T is the absolute temperature. This equation is strictly valid only for an idealized liquid: one consisting of hard, rigid and attractionless spherical molecules. In this work it was applied to various liquids in an attempt to see how important various molecular properties may be in determining the results.

The collisional contribution turned out to be about one-third or one-half of the experimental viscosity. It decreases with increasing temperature somewhat more slowly than the latter. The molecular shape and flexibility were found to be quite important in determining the collisional contribution.

The second part of this work consists of an attempt to account for the attractive intermolecular forces present in a liquid which contribute to the viscous resistance. The following expression was derived for this attractive interaction contribution, η_{a_1}

$$\eta_a = \frac{\epsilon}{36\sigma^2 \langle s \rangle} \sqrt{\frac{m}{2\pi kT}}$$

where ϵ is the interaction parameter of the Sutherland potential, $\langle s \rangle$ is the mean free path and the other symbols have the same meaning as above. The difficult step in the derivation of this equation consists in finding a suitable expression for the density of nearest neighbors in space surrounding a given molecule in a liquid subjected to a viscous shear.

The results obtained from the latter equation are quite unreasonable and it is not clear which assumption used in the derivation is the weakest one.

The third part of this work represents the derivation of an expression for the viscosity of a liquid based on a simple model. It is supposed that those molecules which have sufficient thermal energy to separate from one or more of their nearest neighbors by a certain distance contribute to the fluidity of a liquid in that they constitute what could be called weak points of the liquid quasi lattice. The final equation obtained is

$$\eta = \frac{K}{2} \left(\frac{kT}{2}\right)^{7/6} \oint \left(\frac{K}{a^6 kT}\right) \frac{5}{v^{2/3}} \frac{e^{E_\eta/kT}}{\nu}$$

where K is the force constant of the Sutherland potential, a is the average distance between centers of neighboring molecules, E_η is the energy of dissociation of a pair of molecules, ν is the thermal vibration frequency of molecules in a liquid and

$$\oint \left(\frac{K}{a^6 kT}\right) = \frac{\int_{K/a^6kT}^{\infty} e^x X^{-1/2} dX}{\int_{K/a^6kT}^{\infty} e^x X^{-2/3} dX}$$

The other symbols have been defined previously.

A number of comparisons of results from this theory with experimental data showed that this latter approach might well lend itself to the a priori calculation of the viscosity. It seems to be possible to extend the treatment to include viscoelastic liquids as well as binary mixtures.

198 pages. $2.48. Mic 56-1686

POLAROGRAPHY IN ACETONITRILE

(Publication No. 16,552)

Johannes Francois Coetzee, Ph.D.
University of Minnesota, 1956

Acetonitrile possesses many of the requisites of a good polarographic solvent: it is a fair solvent for inorganic salts, an excellent solvent for most organic compounds; it has a reasonably high dielectric constant; it has a convenient liquid range and a low viscosity; it has a wide polarographic range; and it is not unduly hazardous. Its main defects are its relatively high vapor pressure and its susceptibility to hydrolysis.

The more soluble inorganic salt types in acetonitrile are perchlorates, iodides and thiocyanates. Strongly polar chlorides and bromides (of the alkali metals for instance) possess only very limited solubilities in acetonitrile.

The general usefulness of acetonitrile as a polarographic solvent was illustrated for a large number of inorganic and several selected organic compounds.

Acetonitrile is a useful polarographic solvent over a considerably wider potential range than water (+0.6 to -2.8 V. vs. S.C.E., as compared to +0.4 to -2.4 V. in water). Noble metal (platinum or gold) electrodes are especially useful in acetonitrile, since they can be used over an extremely wide potential range extending from +1.8 to -1.5 V. vs. S.C.E., whereas in water the potential range which can be attained is much more limited (+1.1 to -1.1 V. vs. S.C.E. in a neutral solution).

There is very considerable experimental evidence for the postulate that the basic and especially the acidic properties of acetonitrile are much weaker than those of water. It was pointed out that acetonitrile should be an excellent solvent for the differential titration of acids and bases. From the polarographic point of view the main implications of the weak acidic properties of acetonitrile are the following:

1) Electrodes can be polarized to much more negative potentials in acetonitrile than in water before the solvent is reduced.

2) Metals like beryllium and magnesium, which cannot be electrodeposited from aqueous solution because the solvent is reduced, can be electrodeposited

from acetonitrile as solvent, though some hydrogen evolution also occurs.

3) Anions are only very weakly solvated by acetonitrile. This in turn has two major implications from the polarographic point of view:

3.1) Metal complexes with anions are generally much more stable in acetonitrile than in water. For instance, in acetonitrile as solvent the polarographic half-wave potential of zinc chloride is 0.65 volt more negative than that of the simple (solvated) zinc ion.

3.2) Anions such as hydroxide, thiocyanate and the halides, depolarize the dropping mercury electrode at much more negative potentials in acetonitrile than in water.

The main implications of the relatively weak basic properties of acetonitrile are the following:

1) Cations generally have lower solvation energies and are therefore reduced at more positive potentials in acetonitrile than in water. Exceptions are silver and cuprous copper ions, which exhibit a more or less specific tendency to coordinate with acetonitrile. The difference between the half-wave potentials of a given metal ion in acetonitrile and in water is greatest for those ions which, like Mn II, Co II, Ni II, Fe III, Cr III etc., are especially strongly hydrated in aqueous solution. In certain instances, such as those of H^+, Co^{++} and Ni^{++}, the rate of electroreduction of the solvated ion appears to be more rapid in acetonitrile than in water.

2) "Acidic" cations, such as Be II, Al III, Fe III, etc., are much less solvolyzed in acetonitrile than in water.

3) Acids are much weaker in acetonitrile than in water. Acetonitrile acts as a differentiating solvent for acids which appear to have the same strength in a leveling solvent like water. Perchloric acid behaves as a typical strong electrolyte in acetonitrile up to about 10^{-2} M concentration, while hydrochloric and sulfuric acids do not. The solvated proton behaves as a "super-acid" in acetonitrile. 198 pages. $2.48. Mic 56-1687

THE INFRARED ABSORPTION INTENSITIES OF ETHYLENE AND SOME DEUTERATED ETHYLENES

(Publication No. 14,552)

Ralph C. Golike, Ph.D.
University of Minnesota, 1955

Integrated absorption intensities of the fundamental and some overtone and combination bands of C_2H_4; C_2D_4; and cis, trans and asymmetric $C_2D_2H_2$ were measured using experimental techniques similar to those of Penner and Weber. No attempt was made to interpret the data on the overtone and combination bands or those on asymmetric $C_2D_2H_2$.

The interpretation of data on the fundamental bands of the other four isotopes was based on the fact that the derivatives of electric moment with respect to the symmetry coordinates should be equal for the different isotopes. This is true because the symmetry coordinates were set up for C_2H_4, the isotope of highest symmetry, and because the force constants are assumed to be unchanged by deuterium substitution.

For the purpose of interpretation the data were considered in four different groups. Values of the above derivatives calculated from the intensities of the out-of-plane modes of the different isotopes agree within about seven percent. Although this difference is greater than statistical errors predict, a number of factors could be involved; hence, the difference is not thought to be excessive.

Since C_2H_4 and C_2D_4 have the same symmetry, it is possible to make a direct comparison of derivatives calculated from the intensities of in-plane modes of the two molecules. The ambiguities in sign which arise when the square-roots of the intensities are taken yield several sets of derivatives for each molecule. This comparison of data from the two isotopes made possible the choice of a preferred combination of signs, since only one combination gave agreement within the calculated errors. Due to mixing of the symmetry species and the overlapping of bands it was not possible to extend this direct comparison to the data on cis and trans $C_2D_2H_2$. It was necessary to use values of the derivatives of electric moment with respect to symmetry coordinates as obtained from C_2H_4 and C_2D_4 and calculate values of the intensities of the bands of these molecules. The uncertainties in sign mentioned above lead to several sets of values; however, a comparison of experimental and calculated intensities of trans $C_2D_2H_2$ showed that the best agreement arose from the preferred combination of signs. The data on cis $C_2D_2H_2$ were consistent with this preferred combination of sign but added no support of it.

On the basis of the above comparison it was possible to choose a preferred set of derivatives; and since the values are "over-determined," they should be very reliable. These values were used to calculate effective charges and bond-moments. They agreed reasonably well with those calculated from existing intensity data; however, the discrepancies between those calculated from the different symmetry species still exist. Although the bond-moment hypothesis may be used in a qualitative manner, it must be concluded that it is not valid for quantitative calculations. 162 pages. $2.03. Mic 56-1688

CATALYTIC HYDROGENATION OVER COPPER-NICKEL ALLOYS

(Publication No. 16,511)

W. Keith Hall, Ph.D.
University of Pittsburgh, 1956

A kinetic study of the catalytic hydrogenation of benzene and of ethylene over a series of copper-nickel alloy catalysts was undertaken with several objectives. The first of these was to obtain activation energy data for these reactions as a function of alloy composition with a view to providing a critical test of the theoretical development, provided by D. A. Dowden, relating these activation energies to properties of the solid state. A second objective was to attempt to resolve the apparent discrepancy between this theoretical development and the data recently published by R. J. Best and W. W. Russell for the hydrogenation of ethylene over a similar series of alloy catalysts.

The study of the hydrogenation of benzene was carried out using conventional techniques in al all-glass system of

the type used in high vacuum work. For the study of the hydrogenation of ethylene, however, a new "microcatalytic" technique was adapted to the requirements of the experiments. This technique had three major advantages. The first of these was that the catalytic activity could be studied as a function of the (relatively small) amount of synthesis gas that had passed over the catalyst; it was therefore particularly useful for observing the phenomena of poisoning and promotion by the reactant gases. A second advantage was that it eliminated large temperature gradients in the reactor. Lastly, it was possible to follow the reaction in a semi-quantitative fashion during the course of the experiment.

The isothermal activity data obtained for the hydrogenation of benzene was quite similar to the data which Dowden and Reynolds obtained for the same reaction over copper-nickel alloy catalysts in that the activity dropped sharply near the critical alloy composition of 60 atom per cent copper. They resembled, also, the data of these same workers for the hydrogenation of styrene over similar catalysts. The activation energies for the benzene hydrogenation obtained in the present work, however, showed that the explanation offered by Dowden for the earlier data could not apply to the present work. According to that explanation the activation energy should increase, and the frequency factor should decrease as copper is alloyed with nickel, whereas the present observations show that these parameters increase and decrease together; both decreases near the critical composition.

In the studies of the hydrogenation of ethylene, contrary to what might be expected from the aforementioned behavior of styrene, no break in the isothermal activity curve was observed near the critical composition. A possible explanation of this behavior is offered in terms of a mechanism in which cancellation occurs between the important electronic variables of the solid.

A form of chemisorbed hydrogen was found to act as a promoter on all of the alloy catalysts and as a poison to the pure nickel catalyst in the low temperature hydrogenation of ethylene. This observation, along with the apparent independence of the kinetics on the magnitude of the hole in the d band accounts adequately for the results of Best and Russell.

The trends in the parameters, observed in the present work, are in accord with a hypothesis suggested earlier by J. H. de Boer to the effect that a compensating (in the present instance, an over-compensating) increase in the frequency factor with increasing activation energy (and conversely) comes about through changes in the work function caused by adsorption of gas.

131 pages. $1.64. Mic 56-1689

SOME THERMODYNAMIC AND FLOW PROPERTIES OF AQUEOUS SOLUTIONS OF TWO AMINO SULFONIC ACIDS

(Publication No. 16,516)

Wilbert Eugene Keder, Ph.D.
University of Pittsburgh, 1956

Results of measurements of certain properties of aqueous solutions of non-polar, electrolyte, and di-polar solutes have been interpreted recently in terms of alteration of the structure of water. This research is part of a program of further investigation in this area.

Densities and relative viscosities of aqueous solutions of taurine (2-aminoethane-1-sulfonic acid) and 2-aminobutane-1-sulfonic acid have been measured over a range of compositions at 20°, 25°, and 30°C. As criteria of purity solubilities of each compound in water at the three temperatures were obtained. From the change of relative viscosities with temperature, differential activation energies for viscous flow were calculated. These values were compared to literature values of the same function for corresponding amino carboxylic acids.

Vapor pressures of aqueous solutions of these two compounds were measured at 25°C. by the isopiestic method. Osmotic coefficients and activity coefficients of the solutes were calculated. Activity coefficients were compared with those of the carboxylic analogs found in the literature.

Some preliminary heat of dilution measurements were made on solutions of these two compounds. From these and the vapor pressure results tentative $\overline{S}_1 - \overline{S}_1^0$ values were calculated. These also were compared with values of the same property for corresponding amino carboxylic acids.

Tables of raw data and calculated results are given as are expressions derived by the method of least squares for most of the measured and calculated properties.

The behavior of these members of the amino sulfonic acid series closely parallels that of the amino carboxylic acid series. Increase of chain length causes decrease in the differential entropy of dilution and in the differential activation energy for viscous flow, both quantities being positive in sign for the shortest-chain compounds. Thus the earlier conclusions that the amino acid grouping breaks water structure and that the hydrocarbon groups have the opposite effect are substantiated. From the fact that these functions for the amino sulfonic acids show more positive values than those of the amino carboxylic acids of comparable chain length, it was concluded that the amino sulfonic acid grouping is more effective in breaking water structure than the amino carboxylic acid grouping.

71 pages. $1.00. Mic 56-1690

THERMODYNAMIC AND INTERMOLECULAR PROPERTIES OF BINARY LIQUID SYSTEMS

(Publication No. 16,476)

James Edward Lewis, Ph.D.
Purdue University, 1956

Major Professor: Charles R. Mueller

An experimental laboratory has been set up for the physical chemical study of binary liquid systems. This laboratory is designed to work in a cooperative effort with the theoretical investigation of the liquid state, and to provide data and information for the testing of the theoretical advances in this study.

Binary liquid systems of non-electrolytes, that do not exhibit hydrogen-bonding, and that do exhibit critical phenomena are of particular interest. The system studied in particular here consists of hexadecafluoro-n-heptane and

2,2,4-trimethylpentane. This solution has its critical solution temperature at 23.7°C. which permits measuring its properties at or near room temperature and still be in the proximity of the critical solution temperature.

This research has been concerned primarily with designing the laboratory and carrying out the measurement of the properties of the above system.

The problem of purifying fluorocarbons is discussed and the necessity of using selective adsorption to obtain high purity is illustrated. In this case the perfluoroheptane was passed through a 40-foot column, 0.75 inches in diameter, containing colloidal silica gel, in order to reach a purity of 99.95 mole percent.

The volume changes of mixing for the system were determined via density measurement at 30.00°C. A maximum of 3.2% positive deviation was observed at 0.56 mole fraction of iso-octane.

The vapor-liquid equilibria for the system was determined at 30°, 50°, and 70°C. measuring about 15 points at each temperature. The procedure was to measure the total pressure of a steady state system at a fixed temperature and then analyze the liquid and vapor. An equilibrium still was used, similar to that designed by G. Scatchard, but modified for distilling a system a few degrees above its critical solution temperature. It was found to be necessary to stir the condensate in order to reach a steady state. The pressure is read with precision manometers and a cathetometer to ± 0.04 mm. The temperature is read with a platinum resistance thermometer to ± 0.001°C.

Methods for interpreting this data and calculating the free energies, entropies, and heats of mixing are presented with the calculated values.

An apparatus for measuring gaseous viscosities has been designed based on the principle of the torsion pendulum. The viscosities of the mixed vapors and the pure components of the above system have been measured at 30°, 50°, and 60°C. The practicality of using conventional methods for calculating intermolecular potentials is discussed, and a new method based on the law of corresponding states and thermodynamic data is presented. This is not concluded and is still under investigation.

A new isothermal calorimeter for measuring positive heats of mixing has been designed. This utilizes twin calorimeters to eliminate troublesome corrections and a pair of differential thermistors for controlling the electrical heater circuit. There is no vapor space and the rate of mixing is controlled so that the heat absorbed is automatically compensated so that the maximum temperature change is of the order of 0.001° to 0.002°C. This is accomplished by a new electronic differential thermistor bridge designed in this laboratory. The circuit diagram is presented, as well as the current measuring circuit.

The heats of mixing of perfluoroheptane and iso-octane were measured at two compositions and the data compared with the values calculated from vapor pressure data. The agreement is 4.5 per cent. Known errors in the calorimeter are discussed and suggestions for improvement given. 151 pages. $1.89. Mic 56-1691

COMPLEXES OF ETHERS WITH DIBORANE

(Publication No. 16,657)

Franklin Everett Massoth, Ph.D.
Syracuse University, 1956

Phase diagrams of the systems: diborane-diethyl ether, diborane-methyl ethyl ether, diborane-dimethyl ether, diborane-tetrahydrofuran, diborane-tetrahydropyran, diborane-perfluoro-ether and diborane-cyclo-C_4F_8O were studied by standard freezing point methods. Mixtures of known composition were made up by gas measurements in a calibrated volume. The materials were transferred to the freezing point cell by condensation with liquid nitrogen. The rate of cooling was regulated by variation of the position of the liquid nitrogen bath surrounding the cell jacket. Temperature-time curves were obtained directly by a continuous electronic recorder, using a copper-constantan thermocouple to determine temperature.

Borine complexes of the type ether:BH_3 were found for dimethyl ether, diethyl ether, tetrahydrofuran and tetrahydropyran. The relative stabilities were: $Me_2O{:}BH_3$, $C_4H_8O{:}BH_3$, $C_5H_{10}O{:}BH_3 >> Et_2O{:}BH_3$. Diethyl ether also formed a second, weaker complex, having the empirical formula, $Et_2O.1\ 1/2B_2H_6$. It is suggested that this may be a combination of a borine complex and a boron to carbon coordination complex. Methyl ethyl ether formed a weak complex corresponding to $MeEtO{\cdot}B_2H_6$. This is explained on the assumption of boron to carbon bonding. Diborane formed no complex with perfluoroether or cyclo-C_4F_8O. The stability of the various diborane-ether complexes were interpreted in terms of temperature, dependency of the equilibria involved, inductive effect of substituents on the ether, and steric effects.

Studies of the gas phase equilibrium of diborane and dimethyl ether were made. Equilibrium constants were determined by measurements of the pressure decrease resulting from complex formation. Accurately measured quantities of the gases were mixed and the observed pressure compared to the pressure calculated assuming no interaction. The materials were transferred to the reaction system by vacuum condensation techniques. A differential manometer was employed in conjunction with a wide-bore precision manometer to determine total pressures.

The reaction between diborane and dimethyl ether in the gas phase was found to obey the equilibrium:

$$Me_2O + 2B_2H_6 \rightleftharpoons Me_2O{\cdot}2B_2H_6$$

The equilibrium constant at 1.1°C. was calculated to be $4.4 \times 10^{-2} \pm 1.0$ atm.$^{-2}$. Values for the thermodynamic constants ΔH, ΔF^0, ΔS^0 at 1.1°C. were computed to be -3.1 k cal./mole, 1.7 k cal./mole and -17 e.u., respectively. Boron to carbon bonding was advanced to explain the high diborane to ether ratio. Other methods of interpreting the data were found to be unsatisfactory.

62 pages. $1.00. Mic 56-1692

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

GAMMA-RAY INITIATED POLYMERIZATION OF CRYSTALLINE VINYL MONOMERS

(Publication No. 16,049)

Alfred J. Restaino, Ph.D.
Polytechnic Institute of Brooklyn, 1956

In order to determine whether the ordered arrangement of molecules in the lattice of crystalline vinyl monomers influences the rate of polymerization and the structure of the resultant polymer, a number of vinyl compounds have been polymerized in the solid state by gamma-rays from Co^{60}. Those monomers polymerized include acrylamide, methacrylamide, methylene-bis-acrylamide, vinyl carbazole, vinyl stearate, acrylic acid, methacrylic acid, and potassium, calcium and barium acrylates. The molecular weight of polyacrylamide obtained at low conversion was constant with a 270-fold variation of radiation intensity and in the temperature range 20 to 65°C., but increased slightly with the energy of the radiation. The polymerization rate, however, was linear with field intensity, independent of the energy of radiation and had an over-all activation energy of 4.67 kcal./mole. Irradiation of acrylamide at -179°C. produced "frozen-in" radicals in concentrations of the order of 10^{-4} molal. In the polymerization of vinyl stearate the temperature dependence of rate and molecular weight exhibits a significant discontinuity on passing through the melting point of the monomers. With barium acrylate there is no significant variation in polymerization rate between 10 and 65°C. Cyrstalline maleic anhydride, allyl amine hydrochloride and picrate, and stilbene did not polymerize on exposure to gamma-rays.

The studies clearly indicate one unique feature of solid state polymerizations that is not obtainable with polymerization of liquid monomers. Thus, the polymerization of crystalline acrylamide and potassium acrylate with gamma-rays produces throughout the entire conversion of monomer, a polymer having the same degree of optical birefringence as the unpolymerized monomer crystal. This demonstrates that long range order is maintained in the polymer possibly due to polymerization in preferred crystallographic directions. 46 pages. $1.00. Mic 56-1693

CHAIN BRANCHING IN LINEAR POLYPHOSPHATES; KINETICS AND MECHANISM OF HYDROLYTIC DEGRADATION

(Publication No. 16,692)

Theodore Leo Treitler, Ph.D.
Rutgers University, 1956

The previously observed occurrence of an initial decrease of both viscosity and pH in freshly prepared aqueous solutions of sodium polyphosphate was investigated with samples whose Na/P ratios ranged from 0.968 to 1.055. The phenomenon was observed at Na/P ratios up to 1.01. That the effects were due to the hydrolysis of weak bonds in polymer molecules was indicated by the observation that the first-order rate constants of both the reduced-viscosity decrease and the increase in the number of titratable-hydrogen ions were equal but several orders of magnitude greater than reported rate constants for the linear P-O bond hydrolysis. Impurities, which might conceivably cause such weak bonds, were not found to be present in sufficient quantities to account for the magnitude of the observed effects. Therefore, it was concluded that the weak bonds were at branch points in the polymer chain. This conclusion was confirmed by the fact that two titratable-hydrogen ions were liberated for each end group formed.

The original number of branches in the glassy polymer was estimated by extrapolation of the data obtained in the rate studies. In glasses where the Na/P ratio was greater than unity, the number of branches was of the order of one branch for every 1000 phosphorus atoms. The first-order rate constants found were: $0.46(\pm.03)\times10^{-3}$, $8(\pm4)\times10^{-3}$, and $64(\pm2)\times10^{-3}$ min.$^{-1}$ respectively, for temperatures of 0°, 25°, and 45°. These rate constants were found to be independent of changes of pH (in the range of 4.5 to 11), the Na/P ratio, molecular weight, ionic strength and the dielectric constant of the polymer solutions.

The energy of activation, E, and the frequency factor, A, were determined from the temperature dependence of the rate constants. The energy of activation for branch hydrolysis was found to be 18.9 kcal./mol., which is about 7 kcal./mol. less than the reported values of 26±2 kcal./mol. which had been given for linear-chain hydrolysis. By use of the Eyring equation the "entropy of activation" for the transition state was found to be about -15 E.U. This value was approximately equal to that found for linear-chain hydrolysis; on the basis of this result it was considered likely that the transition states for both processes were similar.

It is proposed that the mechanism for branch hydrolysis is a nucleophilic displacement on phosphorus of a -O-P chain fragment with water as the nucleophile. The possibility of an ionic mechanism was eliminated by the observation that the rate of branch hydrolysis was not affected by changes in the dielectric constant or in the ionic strength of the polymer solutions.

A similar mechanism had been proposed for linear-chain hydrolysis. That the latter type of hydrolysis is dependent on pH and ionic strength is explained in terms of the negative charge on the phosphate group on which the nucleophilic displacement is occurring, – in contrast to the uncharged phosphate groups at branch points. It was also suggested that the observed formation of metaphosphate rings from linear chains might be due to a nucleophilic displacement on phosphorus by an oxygen atom of the polyphosphate chain. 110 pages. $1.38. Mic 56-1694

THE HYDROLYSIS OF p-NITROANILIDE-ACID COPOLYMERS

(Publication No. 16,050)

Edward W. Westhead, Jr., Ph.D.
Polytechnic Institute of Brooklyn, 1956

A previous investigation has shown, that in polyacrylic acid carrying a small number of ester groups, the attack of neighboring carboxylate groups on the ester, controls the solvolysis rate over a broad range of pH. The present work was undertaken to determine the characteristics of

similar neighboring group effects in the hydrolysis of p-nitroanilide substituents of some polymeric acids.

Four anilide-acid copolymers were prepared from acrylic and methacrylic p-nitroanilides and acids. Rates of their hydrolysis were studied spectroscopically and compared with reaction rates of low molecular weight p-nitroanilides. The hydrolysis rate of an acrylic acid-p-nitroacrylanilide copolymer at 135.5°C. fell with rising pH up to pH 1.5, remained constant in the range of pH 1.5 and 6 and continued to decrease in more basic solution. This behavior was interpreted by postulating, that in any but strongly acid solution, the reaction rate is controlled by the attack of an unionized neighboring carboxyl group on the anilide linkage. Both the pivalic anilide and the glutaric mono-anilide showed normal acid-base catalysis in the pH range 1 to 8, suggesting that two neighboring groups were involved in the unusual behavior of the copolymer. Measurements of the hydrolysis rate at various degrees of neutralization of the copolymer indicated that the state of ionization of the second neighboring carboxyl is of relatively little importance.

Over the same pH range, an anilide derivative prepared from a copolymer of maleic anhydride and methacrylic acid reacted to form an imide instead of hydrolyzing. A maximum rate constant near pH 5 showed that the imidization required the p-nitroanilide group to be flanked by one unionized and one ionized carboxyl group. The mono-anilide of succinic acid did not form an imide under the same conditions.

In 1N base, the acrylic anilide-acrylic acid and methacrylic anilide-methacrylic acid copolymers hydrolyzed much faster than the methacrylic anilide-acrylic acid and acrylic anilide-methacrylic acid copolymers. The second order rate constants at 84.4°C. for hydrolysis of all of the copolymers were over one hundred times slower than those of the low molecular weight anilides. Hydrogen bonding was postulated to explain this effect. The maleic anhydride copolymer derivative was hydrolyzed faster than any other copolymer.

In strongly basic solution both polymeric and low molecular weight p-nitroanilides ionized as weak acids with a $pK_a = 14.3$.

Molecular weight, copolymer composition and introduction of styrene into a terpolymer were without effect on the rate of hydrolysis in strong base, but the rate increased significantly on addition of polyacrylic acid.

Barium ion in concentrations up to ten millimoles per liter was found to accelerate the rate of basic hydrolysis of the copolymers by as much as a factor of twenty in 0.4N sodium hydroxide – and increase in hydroxide concentration decreased the barium effect. In the range of carboxyl catalyzed hydrolysis, barium had an inhibiting effect on the hydrolysis.

All these observations demonstrate, that reaction rates of polyelectrolyte substituents differ from those of low molecular weight analogs not only due to the charge of the polyelectrolyte but also because of specific chemical effects of neighboring groups on the macromolecular chain. 109 pages. $1.36. Mic 56-1695

MOLECULAR PARAMETERS FROM LIGHT SCATTERING IN RELATION TO INTRINSIC VISCOSITY

(Publication No. 16,529)

Paul Michael Yavorsky, Ph.D.
University of Pittsburgh, 1956

The primary objective of this investigation was to test the Flory-Fox intrinsic viscosity theory, the one most popularly applied at the present time to the study of polymeric systems. A secondary objective was the establishment of empirical relationships between intrinsic viscosity and molecular weight for a new polymer on which such fundamental information was not yet available. The relatively new and important polymer, polydimethylsiloxane, was chosen for this investigation.

Three-step fractionation and refractionation of purified polymer by partial precipitation from very dilute solutions yielded nine narrow fractions for study. Absolute values of the molecular parameters, molecular weight and molecular end-to-end distance, were measured by light scattering techniques, using a highly sensitive instrument constructed by the author. Both methods of interpreting light-scattering data, the dissymmetry method and the Zimm method, were applied to measurements on benzene solutions, yielding comparable results. Therefore, the less involved dissymmetry method alone was applied to measurements extended to other solvents. The light-scattering results are used in conjunction with measured intrinsic viscosities to test directly the theory as illustrated by the following results.

Molecular weights and end-to-end distances of the nine fractions were first measured in benzene. Intrinsic viscosity of the fractions were determined in benzene and in methyl ethyl ketone, an "ideal" solvent, establishing the empirical relationships between molecular weight and intrinsic viscosity. The light-scattering and viscosity results agree well with the Flory-Fox equation that predicts that the intrinsic viscosity is proportional to the ratio of the cube of the end-to-end distance to the molecular weight. The proportionality constant, ϕ, was found to have a mean experimental value of 2.1×10^{21}, in good agreement with results on other polymers. The value of the ratio of end-to-end distance to square root of molecular weight for the benzene solutions is essentially independent of molecular weight over a range of 0.36×10^6 to 4×10^6. The extension ratio, α, for the fractions in benzene is not very large and shows only slight, if any, variation. Viscosity data of the methyl ethyl ketone solutions, taken at the temperature when the solutions are deemed "ideal," show the intrinsic viscosity to be proportional to square root of molecular weight. All the above results are in sufficient compliance with behavior predicted by the Flory-Fox theory to serve to corroborate it.

Similar measurements were carried out on the same fractions in toluene, and empirical relationships between molecular weight and intrinsic viscosity were established for this solvent also. However, the results of the toluene solutions show serious disagreement with the Flory-Fox theory. Here the value of ϕ decreases with decreasing molecular weight instead of remaining constant. α, when computed from intrinsic viscosity data, increases with increasing molecular weight as the theory predicts for larger α's, but when determined from measured end-to-end

distances, it decreases with increasing molecular weight. Results of measurements on a single fraction in various mixtures of toluene and benzene suggest permeation of flow lines in the molecular spheres when toluene is present. Following this suggestion, it was found that the strangely behaving results of the toluene solutions seem to fit the Kirkwood-Riseman theory well, if partial permeation at such high molecular weights is assumed. This assumption contradicts the Flory concept of such high molecular weight polymers acting hydrodynamically as impermeable spheres.

56 pages. $1.00. Mic 56-1696

AN AUTOMATIC ADIABATIC CALORIMETER SHIELD CONTROL. LOW TEMPERATURE HEAT CAPACITY AND RELATED PROPERTIES OF ZINC.

(Publication No. 16,530)

Michael G. Zabetakis, Ph.D.
University of Pittsburgh, 1956

The use of precision intermittently heated adiabatic calorimeters to determine the heat capacities of pure metals and metal alloy systems is complicated by the necessity of maintaining adiabatic conditions. This study was undertaken with two objectives in mind: (1) to design, assemble, and test an automatic adiabatic calorimeter shield control. (2) to use this control in conjunction with a precision intermittently heated adiabatic calorimeter to obtain the low temperature heat capacity and related properties of zinc.

The automatic control equipment built during this study was designed to simulate the action of a human calorimeter shield operator in maintaining adiabatic conditions in a low temperature adiabatic calorimeter. The complete control equipment consists of three units to control the temperatures of the top, side, and bottom of the adiabatic shield. A temperature unbalance between each part of the shield and the calorimeter produces a thermocouple voltage which causes a high sensitivity taut suspension galvanometer to deflect a beam of light onto a photomultiplier detector unit. This in turn actuates a relay servomechanism which temporarily alters the appropriate shield heater current so as to eliminate the temperature unbalance as quickly as possible. At the same time the steady state shield heater voltage is modified so as to tend to prevent the recurrence of this temperature unbalance.

This equipment was used to obtain heat capacity data for a high purity annealed cast sample of zinc from 11° to 320°K. These data were used to calculate smoothed heat capacity, entropy, heat content, and free energy function data for zinc at selected temperatures between 12° and 320°K. Debye characteristic temperatures were also calculated at these selected temperatures.

Very small calorimeter temperature drift rates were obtained while determining the above heat capacities. This behavior plus the internal consistency of the experimental data indicate that the automatic adiabatic calorimeter shield control works satisfactorily. The deviations of the experimental heat capacity values from a smooth curve are within approximately 1.0 per cent below 30°K. and 0.1 per cent above this temperature.

66 pages. $1.00. Mic 56-1697

ECONOMICS, COMMERCE—BUSINESS

A STUDY OF THE ACCOUNTING PRESENTATIONS WHICH ARE ESSENTIAL TO THE EXECUTIVE LEVEL OF MANAGEMENT FOR MAKING DECISIONS

(Publication No. 16,509)

Vito Anthony Grieco, Ed.D.
University of Pittsburgh, 1956

This thesis attempts to determine which accounting presentations relating to the internal control of a manufacturing enterprise are essential to the executive level of management for arriving at financial and operational decisions.

Effective accounting presentations represent the device by which top management can reach into every phase of the organization; in many instances, it is the only device available to management in guiding and coordinating all phases of the operation.

The basic data were derived from questionnaires received from 192 executives representing firms which manufacture household appliances and equipment. In order to analyze the data, the corporations were classified according to three capitalization sizes including: more than $1,000,000; $500,000-$1,000,000; and $100,000-$500,000.

Four major accounting categories were studied in order to establish which accounting presentations were essential to executives. These categories included: General Accounting, Internal Auditing, Budgeting, and Cost Accounting.

All data considered in this thesis were classified according to the one per cent level of significance which has been considered adequate in research.

The analysis of the data has revealed that the accounting personnel of the three capitalization groups are not given the opportunity to assist top management as they should. Internal auditors do not prepare programs which measure the effectiveness of company policies and procedures, or which appraise performances. Budget accountants need to concentrate on better methods of forecasting profits. Cost accountants confess a weakness in the use of the breakeven chart technique, and a limited knowledge of the use of statistical techniques for securing cost accounting data.

Accounting personnel of corporations having the largest capitalizations seem to be better prepared to assist their executives because they are given more opportunities to attempt ways of keeping top management informed. The medium-sized corporations are the most in need of improving their accounting personnel so that these executives can be provided with better accounting services.

The major conclusions from this study indicate that better types of accounting presentations are necessary for executive use. The following presentations given by executives of the three corporate capitalization groups are those mentioned most frequently.

1. General Accounting
   (a) Statements analyzing and forecasting the various types of operating expenses.
   (b) The preparation of reports which describe extraordinary conditions when first observed.
2. Internal Auditing
   (a) The preparation of descriptive reports which supply data that have been requested by the executives.
   (b) The preparation of reports which describe inadequate internal controls to management.
3. Budgeting
   (a) Presentations which compile short-term forecasts.
   (b) Reports that use the Profit-and-Loss and Working Capital Methods of Forecasting.
   (c) Presentations which relate departmental budgets to individual responsibilities.
4. Cost Accounting
   (a) Presentations should show costs analyzed with a view to cost reductions.
   (b) Presentations should show accumulation of costs for an accounting period.
   (c) Presentations should use the Profit-Measurement, Cost-Planning, and Control-and-Pricing reasons for accumulating costs.
   (d) Reports should project past performances into standards of future performance.

The major recommendations offered by executives are as follows:

1. General Accounting
   (a) Statements, analyzing, and forecasting:
      (1) capital expenditures.
      (2) changes in working capital.
   (b) Reports that break down company performance according to executive functional areas of responsibility.
2. Internal Auditing
   (a) Presentations which suggest improvement procedures.
   (b) Presentations which coordinate the performances of the company with its objectives.
3. Budgeting
   (a) Reports which analyze variances between budgetary and actual figures.
   (b) Reports which segregate uncontrollable and controllable expenses.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

4. Cost Accounting
   (a) Presentations which show the determination of the turnover of inventories.
   (b) Presentations which indicate the regulation of costs and expenses with variations in volume.
   (c) Presentations which illustrate the use of the Direct-Application, Allocation, and Proration methods of assigning costs.
   (d) Presentations which analyze past performances.
   (e) Reports which compare manufacturing costs over a period of years. 106 pages. $1.33. Mic 56-1698

A STUDY OF THE DEVELOPMENT OF PLANNED SHOPPING CENTERS IN THE SYRACUSE AREA FROM 1950-1955 WITH SPECIAL REFERENCE TO THE EXPERIENCE OF BRANCH HARDWARE STORES IN FOUR OF THESE CENTERS

(Publication No. 16,664)

Robert Lowell Smith, D.S.S.
Syracuse University, 1956

The student of marketing is engaged in the study of a very dynamic field. At times, its innovations appear to be almost as frequent as those of the products and services with which it deals. Such rapid change makes the study of marketing fascinating and challenging. However, the time lag involved between the initiation of the change and the preparation of a body of writings relating to the change presents some very real problems. For the businessman, such information is essential in order to make sound marketing decisions; for the teacher, such information is essential in order to remain abreast of the field.

Perhaps the most dramatic change to occur during the past ten years is the development of the planned shopping center. Prior to World War II, the planned shopping center concept was practically unknown. Today, thousands of these centers stud the national landscape. With the exception of Wyoming, every one of the forty-eight states has at least one center or plans for one. Some of the more populous states have hundreds of them.

Unfortunately, shopping center principles are not nearly as well established as are many of the shopping centers. The development of a body of literature pertaining to this post war phenomenon has lagged far behind the actual construction of these centers. Many successful centers have been built without quite knowing what it was that made them successful. At the same time, many unsuccessful centers have been built without knowing what it was that caused them to be unsuccessful. As a consequence, the shopping center developer and his tenants have been hoping for successful ventures rather than planning for them.

This dissertation does not attempt the herculean task of solving the host of problems which have grown almost as rapidly as the centers themselves and which, at the present time, remain unsolved. To make such an attempt would be presumptuous. The study does accomplish two objectives. It contributes to the sparse body of thought by analyzing the development of planned shopping centers in a specific market area, and it establishes a series of guideposts of value to the hardware retailer in appraising the planned shopping center overtures of real estate brokers.

The study of these centers in the vicinity of Syracuse, New York traces the development since the establishment of its first center in 1950. It deals with such things as the pattern of development, the types of centers involved, the incidence of store types, and the groupings of stores within the centers.

The analysis of the experience of a hardware retailer in four of these centers indicates that the volume of business done by a hardware retailer in a planned shopping center is, in large part, a function of the volume of traffic created by the center. The ability of the center to attract the necessary customer traffic is governed by its size, the rate of growth of the market which it is serving, and the strength of the competition which it must meet.

The study concludes with some observations concerning the growth possibilities of some of the shopping centers in this area. It is apparent that the rush to establish suburban centers has resulted in a number of marginal and submarginal developments. 177 pages. $2.21. Mic 56-1699

THE GUIDANCE IMPLICATIONS FOR HIGH SCHOOL AND COLLEGE STUDENTS, COUNSELORS, TEACHERS, ADMINISTRATORS, AND EMPLOYERS, OF COLORADO LAWS RELATING TO EMPLOYMENT, AND EMPLOYMENT PRACTICES AND OPPORTUNITIES FOR WOMEN IN FIVE SELECTED AREAS OF COLORADO

(Publication No. 13,759)

Virginia Field Smith, Ed.D.
University of Colorado, 1955

Supervisor: Professor Clifford Houston

This dissertation reports the results of research in Colorado on employment practices, as they apply to men and women, in relation to wages, advancement policies, amount of unionization, types of business, types of jobs, and training required for such jobs. The plan for this research included a study of Colorado and United States Laws as they relate to employment in Colorado, the contacting by questionnaire of 500 businesses in five selected areas of the State, and the interviewing (using questionnaire form) of 27.2% of the 500 above mentioned employers.

The aim of the research was to find significant differences in employment practices as they relate to the sexes and from these to draw guidance implications for the future labor force and for employers in Colorado.
Significant differences indicated are:

1. That neither training nor experience are very important to the employer; 2. That employers believe in salary increases based on skill and performance, seniority, and merit, but in practice some of them pay a different wage scale for the same work to men and women; 3. That

employers base promotion on skill and performance but very few women are promoted beyond base jobs; 4. That there is a minimum of unionization, and, in some cases, union wages for the same work vary according to sex; 5. That there has been a large increase in the number of women entering the labor market; 6. That men have monopolized some jobs—women others; 7. That men and women differ in certain aptitudes; 8. That men are better balanced emotionally than women; 9. That men are more reliable and dependable than women; 10. That there is prejudice towards sex in employment; 11. That some employers believe in paying an employee on the basis of number of dependents rather than on the job performance.

These results represent a sampling of 58.8% of employed personnel in Colorado (January 1955), more than 150 different types of business, and more than 250 different types of jobs. Of the 500 businesses contacted, 98.6% responded.

The guidance implications for Colorado are:

1. That employers are interested in youth and the future labor supply; 2. That employers and youth must be helped to recognize the need for and the value of training in order that production and standards of living may be improved; 3. That youth "in training" must be ready to face the fact that training will be of little value on beginning jobs if they choose to work in Colorado; 4. That females can expect employment on base jobs and at base wages in most occupations except those such as nursing, dietetics, etc.; 5. That, since employers are willing to train on the job, they would be willing to cooperate in a school-work program; 6. That a good start for training programs could be in the fields of salesmanship, construction, and human relations since employers have indicated an interest in these specific areas; 7. That employers are interested in a public relations program informing youth of opportunities in small businesses; 8. That the sexes must learn respect for the others' aptitudes; 9. That women must learn to think of work as a career, to accept and assume responsibility, and to deserve promotion; 10. That, to insure the saving of the talents of youth, secondary schools must set up training programs to meet the employment and youth needs, or be willing to lose the State's best potential citizenship to other areas; 11. That employers and youth must be trained to understand the changed role of the female in society. 183 pages. $2.29. Mic 56-1700

THE HISTORY AND THEORY OF AUTOMOBILE LIABILITY INSURANCE RATING

(Publication No. 16,531)

H. Jerome Zoffer, Ph.D.
University of Pittsburgh, 1956

This study was undertaken with the purpose of determining the techniques involved in establishing premium rates for automobile liability insurance. As the result of a continuous series of rate increases since the end of the Second World War, greater attention has been focused on the procedures used by the rating authorities in promulgating rate revisions.

The theory of rating has been analyzed in an attempt to indicate the standards which the rate makers follow in establishing rating formulas. Attention was given to the determination of a proper loss ratio so that exposures might be adequately measured.

To facilitate an understanding of current practices, the history of the rating processes was developed from the initial arbitrary judgment rates of the early 1900's to the complicated theories of recent revisions. The classification systems were also reviewed to illustrate the problem that has existed continually in the automobile liability field of equitably allocating the insurance cost among various classes of insureds. Both the pure premium and the expense portions of the manual premium were considered, so as to indicate any possible basis for criticisms of the rating methods.

Because of the effect of state regulation on the rating structure, the provisions of regulatory acts were examined to point out their influence on rate-making theories. The importance and duties of the rating bureaus, as well as the statistical plans which they have established, were reviewed to stress the importance of cooperative rate making, particularly in recent years. While the emphasis is primarily on private passenger cars, brief mention was made of commercial vehicles, as well as those classed as miscellaneous.

Considerable discussion was devoted to a statement of recent problems in the automobile liability rating field, as well as to new theories which have been developed in an attempt to solve such problems. The rate revisions of the past eight years, with emphasis on Pennsylvania statistics, were discussed in great detail so as to illustrate the actual techniques employed.

To provide further background for an understanding of rating theory, some attention was given to collateral fields which affect automobile liability rating. The problem of the uninsured motorist and the attempts which have been made to alleviate the results of that problem were inspected in so far as they relate to rating theory. The financial responsibility laws and the effect they have had on insurance rating were indicated. Some of the more modern approaches to a noncompulsory system of automobile liability insurance, such as unsatisfied judgment funds and impoundment laws, were also considered. Because of the attention currently being given to the compensation approach to automobile liability, mention was made of the operation and rating methods used in such a system.

Primary emphasis was placed on class-rated vehicles, although attention was called to merit rating plans for individual cars, as well as experience, composite, and retrospective rating plans for fleets. The experience of typical carriers was analyzed to determine the effectiveness of the rating policies over a decade of experience.

It was found that the rating authorities have attempted to incorporate every possible measurable factor in the rating structure, but that economic trends have made scientific rate making extremely difficult. Projection and development factors were calculated to incorporate future trends into present rates, and approval by state officials is indicative of their general acceptance in the rating formula. The past few years have produced great strides in automobile rating theory and it was concluded that even more drastic changes may be expected in an attempt to formalize every possible variable entering into the rating structure. 392 pages. $4.90. Mic 56-1701

ECONOMICS, FINANCE

CONSIDERATION OF THE TREATMENT OF GOVERNMENT IN NATIONAL INCOME ACCOUNTS

(Publication No. 16,228)

Ellis Thompson Austin, Ph.D.
Michigan State University, 1955

This investigation is a consideration of the treatment of the government sector in national income accounting. The current magnitude of government economic activity makes its proper evaluation imperative if national income and product totals are to be meaningful as indexes of welfare.

In this inquiry considerable reliance is placed upon the historical approach. Thus the contributions of prominent authorities on the meaning of income and national income are reviewed. Outstanding among these economists is Irving Fisher whose view that savings are not income stimulated considerable controversy. Full agreement is reached, however, that ultimate income is psychic income, i.e., net satisfaction. Also, substantial agreement was obtained that the best measure of a nation's income and hence welfare is the nation's output of goods and services available for consumption and saving valued at market prices.

A survey of the first comprehensive attempts to measure national income indicates a lack of awareness of the special problems introduced by the government in the evaluation of national income. For example, Charles B. Spahr's estimate of national income in the United States, published in 1896, is characterized by virtual neglect of these problems. Progressive concern over these problems is shown, however, by the successive attempts to measure national income. In making its estimate in 1921 of the United States national income, the National Bureau of Economic Research dealt at length with the government sector, and, in their 1927 publication, Arthur Bowley and Sir Josiah Stamp give major emphasis to the proper treatment of the government sector.

One of the most controversial questions that arises out of government economic activity is whether government interest payments are income or transfer payments. The concensus of both American and British economists is that interest paid on productive debt is income while that paid on unproductive debt is a transfer payment. American authorities, in general, accept the current Department of Commerce practice of counting all interest payments as transfer payments because of the difficulty of making the division between productive and unproductive debt. The conclusion of this study is that all interest payments are income payments since interest is a payment for a service and does not depend upon the productivity of the debt. A further conclusion is that the exclusion of government interest payments may not seriously impair national income estimates as indexes of welfare if this practice is consistently followed—that consistency is one of the most important ingredients in making national income estimate used for comparative purposes.

A second problem deals with the determination of government intermediate product. Three alternative approaches to this problem are used. The specific approach attempts to classify each item of government expenditure as either intermediate or final product. The tax approach assumes the value of government intermediate product to be equal to indirect taxes. The "wholesale" approach either completely rejects or accepts all government purchases of goods and services. All these approaches suffer from inadequacies. But there is general agreement that no objective criteria are available and hence any measure of government product must be conventional. After an examination of these approaches, it is concluded here that the Department of Commerce practice of counting all government purchases of goods and services as final product, is the best convention.

A final problem which is vigorously discussed in national income literature is the meaningfulness of net national product at market prices as opposed to national income at factor costs. It is the conclusion of this study that, in spite of several serious limitations, the net national product at market prices series of the Department of Commerce is the best available index of welfare. It is also concluded that the many arbitrary decisions involved in arriving at a national income at factor costs series render this series invalid as either an index of welfare or factor costs. Out of this discussion a final conclusion is obtained, i.e., the national income and national product series should be identical since they are only two ways of looking at the same thing—the objective index of a nation's welfare. 180 pages. $2.25. Mic 56-1702

THE MORTGAGE MARKET IN MIDDLETOWN, CONNECTICUT

(Publication No. 16,334)

William Noble Kinnard, Jr., Ph.D.
University of Pennsylvania, 1956

Supervisor: Dr. David T. Rowlands

Analysis of the local mortgage market has developed primarily on a deductive basis because empirical studies have been relatively scarce. Five such studies have been intensively analyzed in this study. On the basis of the findings of these studies, three hypotheses concerning the local mortgage market have been proposed for testing and analysis:

1. Differences in the organization and functioning of local mortgage markets stem primarily from differences in the size of the local market, and from geographic or regional differences. The small, non-metropolitan urban mortgage market differs in both organization and activity from the large, metropolitan market. In particular, localization of mortgage lending is more pronounced.
2. The effectiveness of federal programs to stimulate home ownership and to encourage the flow of mortgage loan funds among local markets has varied with the size of the market and of the loan.
3. Non-farm non-residential mortgage financing has occurred on essentially the same terms and conditions as has residential mortgage lending. Here, too, size has been a determining factor.

These hypotheses were tested against data provided for the Middletown, Connecticut mortgage market. Emphasis

was placed on the period 1945-1952, although data for 1920-1940 were presented to give an historical perspective to the analysis. Data on mortgage recordings, building permits and lender policies were derived from primary sources. In addition, specific surveys were conducted to determine borrower attitudes and behavior. Economic data on the Middletown community were gathered to present the mortgage market in its local setting.

The hypotheses were also tested against the data provided in the five market studies considered, and against data for the United States as a whole derived from both private and public sources.

On the basis of the quantitative findings, and of the analysis of the data, three general conclusions were reached:

1. Geographic or regional location is the basic determinant of the structure and functioning of the local mortgage market. Location determines the nature of the local lenders, but the influence of size of market transcends the regional pattern of lending. In particular, the mobility of mortgage loan funds among local markets is largely dependent on the size of the market, as measured by the volume of mortgage lending undertaken within the mortgage market area.

2. The federal programs related to home mortgage lending have been only partially successful in channeling loan funds into the smaller, non-metropolitan mortgage market, and in placing all potential mortgagors on basically the same competitive level. Loan insurance or guaranty have not induced outside lenders to enter markets where small volume has rendered loan placement and servicing costs an effective barrier to inter-market mobility of loan funds. In particular, life insurance companies and commercial banks have not been attracted to the smaller mortgage market through mortgage insurance or guaranty alone.

3. Although only fragmentary data support the conclusion, non-farm non-residential mortgage lending was found to exhibit essentially the same pattern in the local market as does residential mortgage lending. This is particularly applicable in the smaller market. Size of loan is an important factor, often offsetting the general disadvantages of small volume. In general, the smaller, noncorporate business enterprise is at a competitive disadvantage in regard to loan terms. Larger average size of loan has accounted for generally lower interest rates, while risk has been compensated for by larger equity requirements and shorter maturities.

The basic need in mortgage market analysis is more primary data on the local market which is provided on a comparable basis among markets, particularly over extended periods of time and for non-residential mortgage financing. This need can be met only through additional studies of local market areas throughout the United States.

295 pages. $3.69. Mic 56-1703

ECONOMICS, HISTORY

SOME MAJOR FACTORS IN THE DEVELOPMENT OF THE CANADIAN ECONOMY, 1900-1950

(Publication No. 16,156)

Robert Arthur Degen, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Paul T. Ellsworth

This study starts from the truism that the Canadian economy has experienced a remarkable development during the first half of the twentieth century. It has two objectives: to present data descriptive of the most distinctive and characteristic features of the economy through time; to interpret the observed changes in terms of the decisive forces, external and internal, which have caused the transformation. It endeavors to contribute to an understanding of the path taken by a relatively static and immature economy as it emerged to a position of vigorous growth and comparative maturity.

The general plan followed is the division of time into six periods ranging from six to fourteen years. Each of these forms a chapter devoted principally to description, and to some extent to analysis. A final summary chapter is concerned primarily with interpretation of the entire half century.

A recurring theme is the impact of external forces on Canadian economic life. These powerful controlling factors took a variety of forms; they stimulated and shaped economic activity; they also limited Canada's control over her economic destiny. The exogenous stimuli together with Canadian responsiveness to them resulted in rapid capital accumulation and increased productivity during three peacetime booms at the beginning, middle, and end of the period studied. Dependence on external markets stifled progress during the thirties. Two world wars speeded long-term trends toward industrialization and the acquisition of advanced techniques.

Attention is focused throughout the study on population growth and capital formation as they have supplemented the relatively abundant natural resources. Population growth and land settlement were prominent prior to 1914; the rate of population increase then underwent a prolonged decline until a resurgence occurred in the forties and early fifties. Capital entered in a large and increasing stream before World War I, and Canada has been a major debtor nation ever since. The inflow was also heavy during the twenties and after World War II. The relative importance of foreign capital was greatest in the early years; the long-term trend has been for Canadians to finance an increasingly larger share of their investments themselves. Foreign capital has consistently been of great qualitative importance; it has led in the development and control of key basic and secondary industries. Canada had a balance of payments surplus on current account from the mid-thirties until 1950.

The development of natural resources has passed through a series of phases. The wheat lands of the western prairies were appropriated during the first two decades. The rapid rise of the pulp and paper industry began in the second decade and experienced great strides forward in the twenties and after World War II. The nonferrous metals industry received increased attention during

the First World War and the twenties; in the late thirties and since it has been in the forefront of development. Since 1945 oil, iron ore, and aluminum have been outstanding among the fields of expansion. Hydro-electric power developments have been important from the early years of the century.

As Canada has grown the composition of her work force has shifted radically away from primary toward tertiary industries, and manufacturing has become more varied, heavier, and more complex.

The United Kingdom and the United States continue in the fifties as at the turn of the century to be of overwhelming importance to Canada; trade and investment shifts have tied the Canadian economy more closely to the United States. 267 pages. $3.34. Mic 56-1704

EDUCATION

EDUCATION, GENERAL

BACKGROUND AND DESIGN FOR A STUDY OF VITALITY FACTORS IN 4-H CLUB PROGRAMS

(Publication No. 16,631)

Edward William Aiton, Ed.D.
University of Maryland, 1956

Supervisor: Dr. Madelaine Mershon

Drawing upon a wide range of published and unpublished literature and reports, this work records significant developments in the origin, history and status of the 4-H Club movement in the United States, since 1900. Trends in participation and program evolvement are analyzed. Implications and recommendations are drawn for future needs.

Particular attention is given to the educational effectiveness of this youth program as conducted by the Cooperative Extension Service. Reference is made to a set of vitality factors or indicators to be used in the identification and study of superior 4-H programs at the county level. One chapter deals with recommendations for needed research in three carefully considered problem areas: (1) Clarification of 4-H Program Objectives, (2) Improvement of 4-H Program Methods and Content and (3) Improvement of 4-H Organization and Leadership. These study needs were revealed by a comprehensive evaluation and analysis of the literature and research now available. The final burden of this thesis is an outline or design for suggested additional studies of 4-H program vitality at the county level.

Chapter headings include: I, Introduction; II, History and Early Development of 4-H Club Work; III, The Purposes of 4-H Club Work; IV, The 4-H Club Program; V, Results and Accomplishments; VI, Evaluation and Appraisal of the Present 4-H Club Situation; VII, Suggestions for the Development and Projection of Further Studies to Identify High-Vitality Factors in 4-H Club Programs; VIII, Summary; IX, Conclusions; X, Appendix and XI, Selected Bibliography.

The author draws liberally on numerous books and papers for facts, events and trends relating to the early history of 4-H Club work. These are then analyzed and interpreted in terms of their effect on the present program. An extensive presentation on pertinent research findings is presented in Chapter VI. The work contains nine tables, two charts and a carefully selected bibliography, in all, 293 pages of text.

This thesis will be of particular interest to: (1) other students and research workers desiring to identify specific areas needing further study and research; (2) extension administrators, supervisors and specialists who desire a broad overview and appraisal of the present scope and educational effectiveness of 4-H Club programs and (3) college students and others who are preparing for active leadership in Extension educational programs.

307 pages. $3.84. Mic 56-1705

AN ANALYSIS AND COMPARISON OF THE SCOPE AND SEQUENCE OF THE COMPUTATIONAL PROGRAMS IN SELECTED ARITHMETIC TEXTBOOKS

(Publication No. 16,650)

Sumitra Bhargava, Ph.D.
Syracuse University, 1956

The Problem

A study of seven series of arithmetic textbooks of grades 3 through 6, currently used in the schools of the United States, was conducted. The computational programs of addition, subtraction, multiplication and division of whole numbers, fractions and decimals were analyzed and compared with regard to their scope and sequence.

Need for the Study

Textbooks in arithmetic form the basic tool of instruction in the schools of today. Various research studies have shown how closely they are followed by the teachers and by the pupils. In order to improve them and to put them to better use their examination is essential.

Procedure

The topics studied were analyzed into developmental steps. It was found that the number and the varieties of steps developed by each series were different. The following table shows a part of the picture. A, B, C, D, E, F and G represent seven series of textbooks which were analyzed in this study.

NUMBER OF DEVELOPMENTAL STEPS FOR ADDITION AND SUBTRACTION IN SEVEN SERIES OF TEXTBOOKS

Topics	Series	A	B	C	D	E	F	G	Max. No.
Addition		20	28	17	36	26	24	34	58
Subtraction		15	28	20	24	24	16	22	46

Besides these differences in the scope, differences with regard to space allotment were found to be prominent. For example, one series may give 50% of its space for the topic to the development of basic facts and another proportionately may give only 25%.

In order to determine the relationship between the number of steps and the space allotment for each topic, rank order coefficients ρ's were calculated. These ranged from .31 to .84.

Another point of comparison was the grade levels at which each step was initially developed. Each book was divided into tenths and grade levels were assigned to each step. Only those steps which were common to all series could be included in this comparison. Grade level differences ranged from 0 to 1.6. The means of these differences ranged from .38 to .79, and the standard deviations, from .25 to .45.

Again the agreements and the differences on the sequence of the developmental steps were studied only with common steps. Each common step of a topic was assigned a rank according to its place in the book. Kendall's W, the coefficient of concordance, was calculated for each topic. Further, 96^2's were calculated to determine the significance of agreement. These W's ranged from .761 to .962 and showed evidence of high agreement among the textbooks on the sequence of these steps. The totals of these ranks were utilized to make the best statistical estimate of the order.

Conclusions and Implications

The following are some of the main conclusions of the study:

1. The scope of each topic differs from textbook series to textbook series. The number and the variety of steps developed are not the same.
2. The differences in grade levels in developing the same step are many and sometimes large.
3. The amount of proportionate space allotted to each topic and subtopics is not the same in all the textbooks.
4. The agreement on the sequence of common steps is high.
5. Many differences are found with regard to the use of large numbers and also small fractions and decimals.

The whole study shows that although the existence of similarity of development cannot be denied, the diversity in the development of computational programs is extensive.

It is further concluded that continued research is needed to improve the scope and sequence of the computational programs in arithmetic textbook series, to the end that improved textbooks will facilitate learning.

259 pages. $3.24. Mic 56-1706

THE EFFECT OF AN ENTRANCE REQUIREMENT ON SUCCESS IN SELECTED ENGINEERING COURSES: AN EXPERIMENTAL EVALUATION FOR THE SCHOOL YEAR 1953-54 IN THE COLLEGE OF ENGINEERING, INSTITUTE OF TECHNOLOGY, UNIVERSITY OF MINNESOTA

(Publication No. 15,922)

John Norman Clausen, Ph.D.
University of Minnesota, 1955

The purpose of the study was to determine the effects of solid geometry on learning outcomes in freshman courses Engineering Drawing 4 and 5.

This experiment was conducted during the school year 1953-54 utilizing a sample of 348 randomly selected and assigned students matriculating the Fall Quarter in the College of Engineering.

Three experimental treatments were applied. These can be defined in terms of whether or not a student had taken solid geometry prior to completing the courses - Engineering Drawing 4 and 5. Specifically the treatments were as follows:

1. Control Group—students who entered the College of Engineering with a deficiency in solid geometry. These students took solid geometry in college prior to Engineering Drawing 4 and 5.
2. Experimental Group—students who entered the College of Engineering with a deficiency in solid geometry. These students did not take solid geometry prior to Engineering Drawing 4 and 5.
3. Regular Group—students who entered the College of Engineering not deficient in solid geometry. These students took solid geometry in high school.

The experiment was designed to answer the following questions:

1. Is there any difference in mean achievement in Engineering Drawing 4 among students who took solid geometry in college prior to taking Drawing 4; students who never took solid geometry before taking Drawing 4; and students who took solid geometry in high school?
2. Is there any difference in learning outcomes in Engineering Drawing 5 among students who took solid geometry in college prior to taking Drawing 5; students who never took solid geometry before taking Drawing 5; and students who took geometry in high school?

Data were collected for the students on five measures:

1. High School Scholastic Rank
2. Pre-test: Engineering Drawing 4
3. Post-test: Engineering Drawing 4
4. Pre-test: Engineering Drawing 5
5. Post-test: Engineering Drawing 5

Three major conclusions were drawn from the evidence collected which pertains to Engineering Drawing 4:

1. Students who had taken solid geometry in college prior to Engineering Drawing 4 were superior in adjusted mean achievement as measured by the Engineering Drawing 4 post-test to the students who had never taken solid geometry.
2. Students who had taken solid geometry in college prior to Engineering Drawing 4 were superior in

adjusted mean achievement to students who had taken solid geometry in high school.

3. There was no significant difference in adjusted mean achievement in Engineering Drawing 4 between students who had high school solid geometry and students who had never taken solid geometry.

In summary, it was concluded that, within the limits of the design of this investigation, the experimental factor, solid geometry, effected superior learning outcomes in Engineering Drawing 4.

The major conclusions derived from the evidence collected which pertain to Engineering Drawing 5 were as follows:

1. Students who had taken high school solid geometry prior to Engineering Drawing 4 and 5 were superior in adjusted mean achievement in Drawing 5, as measured by the Drawing 5 post-test, to the students who had never taken solid geometry.

2. There was no significant difference in adjusted mean achievement in Engineering Drawing 5 between the students who had taken solid geometry in college prior to Drawing 4 and 5 and the students who had never taken solid geometry prior to taking Drawing 4 and 5.

3. There was no significant difference in adjusted mean achievement in Engineering Drawing 5 between students who had taken solid geometry in college prior to Drawing 5 and students who had taken solid geometry in high school.

In summary, with respect to Drawing 5 it appeared in this experiment that solid geometry generally did not effect superior learning and further investigation is warranted.

272 pages. $3.40. Mic 56-1707

AN EVALUATION OF THE CONFERENCES OF A NATIONAL EDUCATIONAL GROUP TO DETERMINE PLANNING AND ORGANIZATIONAL FACTORS ASSOCIATED WITH GENERALIZED JUDGMENTS MADE BY PARTICIPANTS

(Publication No. 16,387)

George William Denemark, Ed.D.
University of Illinois, 1956

This project was designed to evaluate several national conferences of the Association for Supervision and Curriculum Development in order to determine planning and organizational factors that might be associated with generalized judgments made by participants about those conferences.

Five hypotheses were tested by obtaining comparative ratings of the ASCD 1953 Cleveland and 1954 Los Angeles conferences, each involving an assumption that the conference experience would be improved as a consequence of the introduction of one of the following variations:

1) Use of a special conference orientation issue of the Association's journal, Educational Leadership.

2) Use of a new registration form designed to obtain additional data about the interests and expectations of registrants.

3) Scheduling of school visits in conjunction with the meetings of certain study-discussion groups.

4) Organization of certain study-discussion groups around topics paralleling standing committees of the Association.

5) Planning of a series of clinic sessions on specific job problems of different curriculum worker groups.

To obtain data relevant to these hypotheses an opinionnaire was sent to the 279 persons who had attended both of the conferences and responses were received from 239 of these. After determining the statistical significance of the response patterns for each item correlation coefficients for each alternative choice within significant items were computed. These correlations were then reviewed to determine whether the pattern of r's in any item was monotonic, thus enabling a single correlation coefficient to be computed for the item as a whole.

Of the thirteen opinionnaire items for which single r's greater than $\pm$.18 could be computed, only two directly corresponded to the five hypotheses of the project. Those two related to the use of an issue of Educational Leadership as a conference orientation device and to the scheduling of school field visits for twenty-seven of the study groups. Correlation coefficients of +.58 and +.57 respectively on those items suggested that persons who rated the Los Angeles conference high also tended to react favorably to the value of the orientation issue of the journal and to the use of school observations as a part of the study groups' experience.

One of the most interesting and significant results of the study was its documentation of the central importance of the study group experience in relation to the generalized evaluations of the conference. Seven of the thirteen items with statistically significant correlations with a high rating of the Los Angeles conference were linked in some way to the study groups. The opinionnaire item having the highest positive correlation (+.72) with generalized ratings of the two conferences was one which referred to the quality of leadership in these groups. The next highest correlation (+.66) referred to the quality of group leadership, while a third (+.58) related to the pre-planning and preparation of group leadership teams. While a cause and effect relationship between a "good" study group experience and a favorable reaction to the whole conference cannot be assumed, the data seem to indicate that the two appear together very frequently.

233 pages. $2.91. Mic 56-1708

A STUDY TO DETERMINE WHETHER OR NOT THE JUNIOR COLLEGES IN MISSISSIPPI ARE MEETING ADEQUATELY THE BUSINESS EDUCATION NEEDS OF THE POST-SECONDARY SCHOOL YOUTH IN THE AREA WHICH THESE SCHOOLS WERE ORGANIZED TO SERVE

(Publication No. 15,544)

Lytle Carmack Fowler, Ed.D.
New York University, 1955

The examination of the business education programs of the junior colleges in Mississippi and their value for Mississippi students, based on conditions obtained during the school year 1952-1953, was undertaken for a number of reasons. Among them the most important are: (1) the investigator's belief that the school is obligated to help youth see the relationship between their own abilities, aptitudes, and interest and the available occupational opportunities and requirements for employment; (2) the lack of authoritative data in this area; (3) the growth in importance in semi-professions; (4) the number of youth who now matriculate in the junior college; (5) the inadequacy of present-day training.

The normative-survey method of research was used in collecting data for this study.

The problem has been approached from four directions: (1) that of the socio-economic status of the student population; (2) that of the character of and requirements for business occupational opportunities in Mississippi; (3) that of the actual business curricula offered by the Mississippi junior colleges during the school year 1952-1953; (4) that of the efforts, or lack of them, made by the Mississippi junior colleges to advise the students and to act as liaison between trainee and occupation. The information about the students was obtained from questionnaires answered by 1,078 people attending the Mississippi junior colleges during the school year 1952-1953. Data needed for the identification of occupational opportunities available in the state of Mississippi for post-secondary school youth and the requirements for employment therein were obtained from the 17th Census of the United States, 1950, Population, Third Series, The Labor Force, Occupational Industry, Employment, and Income; Occupational Outlook Handbooks; The Monthly Labor Review; The Vocational World Book Encyclopedia; and Vocational Monographs. The content of various business education curricula was secured from biennial reports submitted by the junior colleges to the State Department of Education and from the 1952-1953 catalogues of the Mississippi junior colleges. The material for the study of provisions for guidance was secured from responses obtained from the administration of a revised Reynolds' guidance check list to those responsible for counseling the students included in the study.

The final effort of the investigator was concentrated on an evaluation of the information accumulated in the four areas mentioned in the preceding paragraph. From that evaluation, the following facts emerge: (1) most of the junior colleges operating in Mississippi during the school year 1952-1953 were then aware that the school had an obligation to offer some type of business education training as was evidenced by the fact that more than 87 per cent of these junior colleges were offering one or more business subjects; (2) the clerical occupations field is a promising one; (3) there are several basic business courses which should be studied by all students seeking employment in the clerical and sales fields; (4) there are other requirements for success in the business field which are not met by current business curricula in the Mississippi junior colleges; (5) there was a lack of uniformity among the junior colleges of Mississippi during the school year 1952-1953 in the descriptive titles of certain business courses offered, in the number of hours of credit which students might earn in certain business courses, in the number of hours a week students were required to meet certain business education classes in order to earn the same number of hours of credit; (6) few, if any, of the Mississippi junior colleges were adequately preparing their students for the better selling and clerical positions; (7) the Mississippi junior colleges were not emphasizing the importance of a command of the fundamental processes; (8) most of the Mississippi junior colleges were becoming aware of the importance of factors other than words-a-minute requirement for the success of students specializing in the secretarial and clerical curricula; (9) most of the Mississippi junior colleges did not have sufficient information about their students for counseling purposes.

It is recommended that the Mississippi junior colleges: (1) initiate and maintain a careful study of the social and economic changes occurring in the world, but more particular in their immediate communities, and relate their findings to educational theory and practice. This means that the junior colleges should provide adequate budgets for curriculum development; (2) strive for uniformity in descriptive course titles, in the number of courses to be offered in each of the business subjects, in the hours of credit to be given in each course, and in the relation between class-meeting hours and credit hours; (3) broaden their business curricular offerings to include more of the basic business education subjects; (4) examine the importance of the command of the fundamental processes as they relate to present-day job requirements; (5) establish central guidance offices directed by trained guidance counselors, where they do not already exist; (6) initiate a really adequate guidance testing program, the results of which might be readily available to the faculty; (7) accumulate more data concerning students; and (8) provide more occupational information. 404 pages. $5.05. Mic 56-1709

THE COMPETENCIES AND PATTERNS OF TRAINING DESIRABLE FOR INSTRUCTORS OF BIOLOGICAL SCIENCE COURSES IN COLLEGE GENERAL EDUCATION PROGRAMS

(Publication No. 16,395)

Ralph Paul Frazier, Ph.D.
University of Illinois, 1956

During the past quarter of a century increasing attention has been paid to the development of general education programs in the colleges and universities of this country. A major proportion of the effort has been directed toward the resolving of philosophical, curricular and methodological problems. However, within the past few years increasing attention has been given to needed reforms in the graduate training of prospective teachers. Most of the suggested modifications have been concerned with teachers

in general and not with teachers of specific subject areas. In its original conception, this study was designed to elicit information from interested persons as to their beliefs of what should constitute a well rounded program of study for individuals preparing to teach college level general biology for general education purposes.

The data were obtained through two questionnaires, an Administrator's Form and an Instructor's Form. The two forms were alike in asking for judgments about instructor competencies and desirable areas of content in the general, special and professional training of instructors. In addition, the Instructor's Form asked for personal data on the instructor, his undergraduate and graduate course work and the nature of the general biology course at his institution.

Since a random sampling was not feasible a "willingness to participate" letter was sent to 630 institutions of higher learning. Of these 286 replied and to each school was sent one Administrator's Form and as many Instructor's Forms as were requested.

As the responses came in the data were coded and transcribed on tabulation sheets. From the tabulation sheets the coded data were punched on IBM cards. The cards were mechanically sorted for each item and the totals recorded on prepared sheets. The tables and maps were prepared from the record sheets.

From the responses received from 131 administrators of general education programs and from 251 biology instructors have been deduced the competencies and patterns of training desirable for instructors of college level general biology courses for general education purposes.

Of the thirty competencies listed all but three were considered to be of sufficient value to be included in the training of the biology teacher. Among the competencies that ranked high were: the ability to explain the basic facts, concepts and generalizations of biological science; to help students find information; and to employ techniques and arrange content in a manner to insure student participation. The three competencies that were considered to be unimportant were: the ability to direct research at the graduate level; to read scientific publications in a foreign language; and to give instruction in only one area of biology.

A broad background of subject matter in the physical sciences, humanities and social sciences is desirable. Included here should be such areas as: chemistry, physics, psychology, rhetoric and composition, speech, geology, anthropology, mathematics, philosophy, geography, sociology, economics, history and literature. This general academic preparation should be concentrated primarily in the first two years of undergraduate study, either as discrete courses or sequences of courses, or, as courses within the broad fields specifically designed for general education purposes.

The special academic preparation of the general biology instructor should include such areas of subject matter as: general botany, general zoology, genetics, physiology, evolution, bacteriology, comparative vertebrate anatomy, ecology, embryology, plant physiology, history of the biological sciences, cytology, entomology, plant taxonomy, endocrinology and histological technique. The course work should be organized so that there is a major in one field (as bacteriology or genetics) but with some work in as many of the other related fields as is feasible. Present graduate programs are preparing teachers well in one or two areas but there is a need to broaden the base.

Professional education courses specifically designed for the teaching of general biology for general education purposes should be a part of the training of instructors. The areas of content that should be included are: methods, materials and techniques of teaching the biological sciences; general education at the college level; problems and trends in teaching the biological sciences; general psychology; psychology of learning; general methods of teaching; supervised teaching; counseling and guidance; measurement and evaluation; problems and trends in teaching at the college level; philosophy and philosophy of education. These areas should be organized as courses or seminars, some of which are required and some elective and provided by the individual departments of zoology, botany and related disciplines. Supervised teaching should be required as internships either in general courses or combined with experience in teaching specialized biology courses.

It is desirable for teachers planning to teach general biology in liberal arts colleges, teachers colleges and universities to have research preparation as exemplified by the doctoral dissertation. The topic of the dissertation should be selected from within the major field of specialization. For teachers planning to teach general biology in junior colleges it may be desirable for them to substitute additional work in the biological sciences, general education, professional courses or some combination of the three for the research.

197 pages. $2.46. Mic 56-1710

PRINCIPLES GOVERNING TEACHER TENURE IN PENNSYLVANIA AND NEW JERSEY AS DETERMINED BY STATE SCHOOL OFFICERS AND THE COURTS IN THEIR INTERPRETATION OF STATUTORY LEGISLATION

(Publication No. 16,375)

Gerald G. Hottenstein, Ed.D.
Temple University, 1956

THE PROBLEM

The main purpose of this study is to determine reasons for affirmed and reversed opinions at any level of appeal above the local school board and to develop principles for the guidance of school boards in dealing with teacher tenure cases.

METHODS OF PROCEDURE

The following steps were undertaken in this study:

1. A review and analysis of the opinions on record that were appealed to the Superintendent of Public Instruction in Pennsylvania from 1937 to 1954.
2. A review and analysis of the opinions on record that were appealed to the Commissioner of Education and the State Board of Education in New Jersey from 1930 to 1954.
3. An analysis of all decisions on record adjudicated by the Courts of Common Pleas, the Supreme Court, and the Superior Court of Pennsylvania.
4. An analysis of all decisions on record adjudicated by the Supreme Court, the Superior Court, and the Court of Errors and Appeals in New Jersey.

5. An analysis of all cases reaching the United States Supreme Court from Pennsylvania and New Jersey.

6. A classification of reasons for the affirmation or reversal of decisions at the various levels of appeal.

7. A summary of the principles evolved from the bases for decisions at the various levels of appeal.

CONCLUSIONS

1. It was constantly evident from cases reviewed by the courts, where school boards attempted to dismiss teachers for reasons other than those appearing in the law, that a teacher could not be dismissed for any reason other than those listed. In New Jersey, however, the general nature of the reasons for dismissal gives school boards wide latitude in the selection of reasons for dismissal. The interpretation of these reasons by school boards varied widely from school district to school district.

2. In both Pennsylvania and New Jersey it has been held by the courts that a teacher's failure to obey reasonable rules and regulations adopted by a school board constituted grounds for dismissal. The cases reviewed clearly indicated that the judgment of reasonableness is determined by the circumstances in each particular case.

3. In Pennsylvania, a teacher may not be dismissed by incompetency unless he has received an unsatisfactory rating on the approved basis for such rating established by the Department of Public Instruction. New Jersey does not have a uniform rating system on its statutes. The absence of a uniform rating system in New Jersey has resulted in a haphazard system of rating for the evaluation of a teacher's competency and differs from school district to school district.

4. The weight of evidence seems to indicate that the courts have been unusually fair in their interpretation of neglect. Their rulings requiring absolute proof of persistence have made it difficult to dismiss a teacher for neglect. The Tenure Act, as interpreted by the courts, in this instance, has provided adequate protection for the teacher.

5. There is no guarantee that one court will interpret immorality the same as another and that outcomes of such cases are always doubtful.

6. Generally, the courts have protected teachers against unfair dismissal on the grounds of economy.

7. The courts have gone out of their way to protect teachers against unfair dismissal resulting from indiscriminate transfer practices.

8. The courts have always upheld the rights of teachers as citizens and they have done so under circumstances where the impact of hysteria was difficult to exclude. Also, they have consistently protected our public school system against infiltration of people with un-American and subversive backgrounds.

9. The Teachers Tenure Act, according to the courts, offers no protection to a married woman who becomes pregnant. This raises a question as to the adequacy of protection offered in this respect and whether the Tenure Act should be amended accordingly.

10. The courts constantly pointed to the fact that procedure as provided for in the law must be rigidly adhered to for it served as a constitutional safeguard to the one charged.

11. It was evident, from a legal standpoint, and from the experience of other administrative bodies, that providing for appeals de novo is a wise and sound provision.

12. The courts have been very fair in their interpretation of what constitutes demotion. The Tenure Laws in this area have provided adequate protection for teachers.

RECOMMENDATIONS

On the basis of the findings and conclusions in this study, the following recommendations are suggested for the strengthening and improvement of tenure legislation in Pennsylvania and New Jersey.

1. The Pennsylvania Tenure Act should be amended to require the same period of time for the acquiring of permanent certification and tenure rights.

2. The Pennsylvania Law could be improved by providing a law board to assist or take the place of the Superintendent of Public Instruction or eliminate the appeal to him entirely, since the number of cases appealed to the courts are almost as large as those heard by him.

3. The New Jersey Tenure Act should be amended to set up more specific causes for dismissal.

4. New Jersey should establish a uniform system under statute for the proper rating of teachers.

5. Provision should be made in the New Jersey Law to establish the provision for appeals de novo.

6. School boards and their solicitors should become familiar with every point in the procedure written in the law and it should be scrupulously observed in order to get judicial consideration on the merits of a case.

7. The Pennsylvania Tenure Law could be strengthened by including a more specific listing of positions that are to receive tenure protection.

8. The Superintendent of Public Instruction and the courts in Pennsylvania should have the right to review suspension action and the Tenure Law should be amended to provide for this review.

9. School boards who, as a matter of policy, adopt rules and regulations governing personnel should evaluate the reasonableness of such rules and regulations in the light of habits, customs and social behavior of the school community.

419 pages. $5.24. Mic 56-1711

AN INSTRUMENT FOR EVALUATING THE TOTAL CHRISTIAN EDUCATION PROGRAM OF AN INDIVIDUAL PRESBYTERIAN CHURCH

(Publication No. 13,758)

William Gerald Jamison, Ed.D.
University of Colorado, 1955

Supervisor: Professor Edwin R. Carr

The purpose of this study was to create an evaluative instrument to be used by committees in individual Presbyterian churches in appraising their Christian education programs. The need for the tool was stressed by leaders in the Presbyterian church and an investigation of the literature showed a lack of comprehensive evaluative devices.

Criteria for the proposed instrument were found in the literature of Christian education. The criteria, 156 in number, were arranged under these headings: organization and administration; leadership; facilities, equipment and supplies; education program for children; education program for youth; adult program; and other program areas.

The criteria were arranged in questionnaire form and sent to a pilot study jury of ten ministers, who were asked to consider the criteria in terms of their importance as standards to be met by four types of churches: large urban, small urban, large rural, and small rural. These jurymen used a six-point scale to register their judgments. Furthermore, the judges were requested to evaluate certain Sunday church school materials. In this pilot study there were discovered errors, which were corrected in a final jury questionnaire.

The improved questionnaire was submitted to a jury of 119 full-time workers in Christian education, 107 of which were selected by workers of the Board of Christian Education of the Presbyterian church and twelve by the writer. Sixty-six (54 per cent) responded with completed, acceptable questionnaires.

The judges, as a whole, indicated that standards for large churches should be higher than for small churches and that they should be higher for urban churches than for rural churches. The differences were greatest in criteria involving details, such as equipment and supplies. Standards involving over-all goals, policies, organization, and administration were not so sharply differentiated. The judges who had had experience in working in rural churches did not agree with the other judges that standards for the rural church should differ so extensively.

The judges rated Presbyterian curricular materials very high and the materials for the other major Protestant publishing houses somewhat above the mid-point of a continuum between "very poor" and "excellent." Materials from conservative publishing houses were rated very low.

A preliminary evaluative instrument was devised and applied successfully by committees of Christian education workers in eleven churches, with the four types of churches being represented. The committees determined the degree to which their churches met the standards listed in the instrument and registered their judgments by using a four-point scale--"standard not met," "standard met to minor degree," "standard met to major degree," and "standard met completely." A few changes in the wording were made as a result of this trial. In five of these churches evaluative committees were divided into two sub-committees and their responses were correlated for the purpose of determining the reliability of the instrument. A coefficient of .74 was computed.

The final evaluative instrument contained a scoring device, the scores being based upon converted means of the responses to the criteria by the jury. This instrument contained 146 criteria rather than 156, the reduction in items being made largely because of duplications and ambiguities.

Copies of the final instrument were sent to all judges and to other interested parties. At the time of this writing it had been used in twelve churches of different sizes in various areas of the nation and had been found to be of value in evaluating programs and motivating groups in the direction of making improvements.

240 pages. $3.00. Mic 56-1712

WHAT NEW YORK CITY ELEMENTARY SCHOOL TEACHERS FEEL IS THE EFFECT OF PRINCIPALS ON THEIR MORALE

(Publication No. 16,605)

Martin Silverman, Ph.D.
New York University, 1956

Background and Design of the Study

This study attempted to identify those specific personal characteristics and daily activities of New York City elementary school principals which might have an effect on the morale of their teachers. It also undertook to determine whether such factors as size or type of school, length of service, extent of formal training, or sex influenced the judgments of the teachers regarding the effect of principals on their morale.

After studying the literature on administration and supervision, as well as on morale; discussing the problem with professors of education, principals in the field and teachers; and analyzing his own experiences and activities as a New York City elementary school principal, the investigator drew up a list of 290 items, each one of which constituted a statement relating to a hypothetical principal's physical and mental characteristics, professional background and experience, personality, everyday human relations contacts with people on the job, and various supervisory and administrative acts.

This list was too lengthy, however, to be used in an instrument to be administered to hundreds of teachers. As a result of a "trial run," therefore, in which 100 New York City elementary school teachers participated, it was reduced to 81 items, a list more manageable in size.

The revised list was now presented to the teachers in eighteen schools representing a cross-section of New York City elementary schools as regards size, type of socio-economic background and location.

The responses of 452 teachers were used as a basis for statistical analysis.

Findings

The following ten items (listed in order of strength) seemed to have the greatest effect on the morale of the teachers:

1. Backs up his teachers in conflicts with parents.
2. Criticizes a teacher in front of others; makes her lose face.
3. Has a good knowledge of current elementary school methods and materials.
4. Does not seem to trust his teachers; is always snooping around.
5. Gives praise and credit where due.
6. Does not hesitate to assume responsibilities or to take a stand; shows initiative.
7. Sneaky; hypocritical.
8. Pays special attention to his teachers' physical comfort. (Furniture for the teachers' room; a minimum of interruptions or conferences during the lunch period; coverage for a teacher who is suddenly indisposed, etc.)

9. Works for the good of the school and the children, rather than for his own personal glory.

10. Allows after-school conferences to drag on until unreasonable hours.

The analysis of the responses to the 81 individual items further revealed that a principal's personality and human relations contacts had more of an effect on teacher morale than his physical or mental characteristics, his professional background and experience, his work as an improver of instruction, or his activities as an administrator. In addition, those items that seemed to have the strongest influence on morale were the ones specifically related to meeting the teachers' need for security.

There were very few significant differences resulting from size or type of school, length of service, extent of formal training, or sex. Except for a few isolated instances, it made little difference whether a teacher was in a small, medium-sized or large school; whether her school was located in a low, average or high socio-economic area; whether she was on probation, on permanent license, or on maximum; whether she was a normal or training school graduate, or had a bachelor's or a master's or other advanced degree; or whether the teacher was male or female. Each item on the list generally produced the same reaction with all teachers.

280 pages. $3.50. Mic 56-1713

PRINCIPLES FOR DESIGNING FLIPCHART GRAPHICS AND THEIR APPLICATION TO TEACHING CONCEPTS OF REGRESSION AND CORRELATION IN UNIVERSITY STATISTICS COURSES

(Publication No. 16,667)

Gilbert Earl Tauffner, Ed.D.
Syracuse University, 1956

This study was concerned with the identification and compilation of principles and procedures for the preparation and use of a flipchart in teaching the statistical concepts of regression and correlation at the university level. A review of the literature in the fields of audio-visual education, perception, conceptual learning, communication theory, and graphic design, was used to develop procedures for the planning, constructing, and evaluating of flipcharts. These procedures were used to design and construct the flipchart on the concepts of regression and correlation. This flipchart was evaluated through the use of student and instructor questionnaires and by experimental comparisons of classes where the flipchart was used and classes where it was not used.

Results From the Student Questionnaires.—Sixty-five students who had been taught regression and correlation by instructors using the flipchart responded to major items on the questionnaire as follows:

1. Sixty-eight per cent of the students felt the chart had been of definite value.

2. Eighty-three per cent felt the appearance was satisfactory; seventy-seven per cent approved the organization of the material.

3. Ninety-two per cent of the students in classes where the instructor had "checked-out" with the flipchart before class use, thought it functioned well.

Results From the Instructor Questionnaires.—Four instructors who had used the flipchart in classes were questioned as to its appearance and effectiveness. As objective data were not available at the time, two instructors hesitated to report on the contribution of the chart to student learning. The others believed it helped. Three of the four instructors felt the charts handled well. All instructors felt the chart was legible and attractive, that they saved time formerly spent at the blackboard and, in general, moved faster over the material. All felt flipcharts of this type would be useful in teaching statistical concepts.

Results From the Experimental Comparisons.—Five comparisons were made between groups where the flipchart was used and groups where it was not used. Control and experimental groups were matched as closely as possible on the basis of a pre-test. Co-variance and t test techniques were used to analyze test score differences. None of the experimental comparisons revealed significant differences between the flipchart and non-flipchart groups. A sixth comparison of a group where the flipchart had been used for a forty minute class period with a group where the flipchart had been used for three hundred and thirty minutes failed to show any significant differences.

General Conclusions.—

1. The principles developed from the review of the literature on the design and construction of flipcharts were satisfactory in that they provided a practical and comprehensive guide.

2. The flipchart designed for this study was considered by students and instructors involved in its use to be well planned, legible, attractive, and appropriate for classroom use.

3. The experimental groups (flipchart) did not do significantly better than control groups on tests, but students in the experimental groups felt that the flipchart had been a definite help in learning the concepts. The value of the chart in contributing to this attitude of confidence is considered to be a valuable one.

4. The difference in responses on student questionnaires from classes where the instructor had carefully "checked-out" on the use of the flipchart and on those from classes where the instructor failed to "check-out", indicated that methods of utilization were important in influencing student attitudes.

170 pages. $2.13. Mic 56-1714

AN INSTRUMENT FOR THE EVALUATION OF A SECONDARY SCHOOL INDUSTRIAL ARTS PROGRAM

(Publication No. 16,646)

Glenn Dayton Warrick, Ph.D.
University of Maryland, 1955

Supervisor: Professor R. Lee Hornbake

This study is primarily concerned with three considerations, namely: (1) the development of a set of criteria for appraising a total secondary school industrial arts program; (2) the incorporation of these criteria into an evaluation instrument which is practicable for teachers, supervisors, and administrators to use locally; and, (3) the experimental application of the appraisal device in three secondary schools.

Evaluative criteria were organized at three levels of desirability. The series of descriptive statements on the lower level made reference to conditions that were considered to be inadequate or poor. The second level referred to conditions considered to be of medium quality. The third level described highly recommended or desirable situations.

These sets of criteria emerged as a jury draft of the evaluation instrument and were divided into three major sections: Section I, "Aspects Relating to the Instructional Program"; Section II, "Aspects Relating to Intra-School and Extra-School Communication"; and Section III, "Aspects Relating to the Physical Plant and Services."

The jury draft of the instrument was mailed to a criterion group of forty members, national in scope, representing the following five classifications: national and state consultants of industrial arts, city supervisors of industrial arts, teacher-educators in industrial arts, administrators with a background in or understanding of industrial arts, and secondary school industrial arts teachers. The purpose of this phase of the development of the instrument was to obtain constructive suggestions for further refinement of the evaluative criteria.

Following the refining and editing process, two junior high schools and one senior high school were selected for the experimental application of the instrument. In addition, an evaluation team of three persons was asked to apply the appraisal device following a brief training period.

Each of the three schools was visited by the evaluators for one day. Data were obtained for the evaluation by (1) interviewing the teacher in each area of the industrial arts program being visited; (2) observing instructional procedures, human relationships, and other aspects of the teaching-learning activities; (3) meeting with counselors, vice principals, and principals in each of the schools visited; and, (4) observing and inspecting the physical plant and facilities.

The data were treated statistically by correlating the independently made ratings of the evaluators; this produced concordant coefficients ranging from .76 to .89 and was significant in establishing the objectivity of the instrument. The reliability of the instrument is inferred from the high agreement between raters. This is demonstrated when the raw scores of the evaluators are converted to standard scores and the differences between raters are compared on the same items in the instrument.

The development and application of the evaluation instrument in this study is an attempt to meet a need for a comprehensive but practicable instrument to assist teachers, supervisors, and administrators in appraising an industrial arts program of a secondary school. The instrument may be thought of as an aid to help teachers evaluate their own program, as a device to provide a basis from which supervisors and teachers may work together for improvement, or as an appraisal instrument to be used by administrators. 269 pages. $3.36. Mic 56-1715

EDUCATION, ADMINISTRATION

AN ANALYSIS OF PUBLIC SCHOOL CITIZENS' COMMITTEES

(Publication No. 16,372)

David L. Cline, Ed.D.
Temple University, 1956

The problem of this study is the analysis of the nature, activities, and contributions of citizens' committees concerned with local public education. Most of the materials were taken from the files of the National Citizens Commission for the Public Schools. They were selected according to an outline built around causative factors, initiating agents and agencies, formative stages in development, membership, organization, cooperative aspects, program objectives, methods and techniques, difficulties, and achievements. These became the headings for ten chapters of analysis and findings.

Some of the conclusions suggested by the findings are:

1. The creation and accelerated growth of the public school citizens' committee movement was influenced by many ideological, social, and economic forces outside the school.

2. The number of citizens' committees for the public schools will increase far beyond the estimated ten-thousand in existence today. More and more school directors, administrators, faculties, student bodies, and others interested in their public schools will find it profitable to study about, cooperate with, and make use of the services of public school citizens' committees.

3. Lay committees develop when enough local citizens feel that more can be done for the public schools than is being done by school officials, by organized state and local groups, or when there is a real or imagined threat to the local school system.

4. The better examples of citizens' committees demonstrate a grass-roots, democratic approach to the solving of public school problems.

5. Memberships of citizens' committees are more likely to be representative of the whole community when the members are named by community organizations rather than by boards of education or the chief administrative officers of the school systems.

6. Democratic participation in public school affairs requires that the work be spread among many people, because of the varied interests, capacities, and times available. Moreover, when this is done, each member feels that he or she has a more definite responsibility to the

committee and is stronger in his or her support of the committee's program.

7. Size of committee does not bear a direct relationship to the effectiveness of the group in securing community support or achieving essential school improvement.

8. Citizens' groups which operate under the domination and control of boards of education or of school administrators are usually less effective than those which operate as independent bodies cooperating with the school authorities.

9. Committees of laymen working for the public schools will probably fail unless they carefully define their purposes; avoid domination by selfish citizens, school administrators, school directors, or local officials; develop organizational flexibility; obtain community acceptance; and adhere to the essential practices of fact-finding, seeking cooperation of school people, and maintaining a representative cross-section of the community in membership.

10. The school-community understanding brought about by the work of a representative lay group makes it difficult for persons and groups wanting to attack the public schools to gain a foothold in the community.

11. The need for services to local public school citizens' groups on the national level has been largely filled by the National Citizens Commission for the Public Schools. The need at the state level is still unfilled in some states, partially filled in others, and there is probably no state-level group prepared to meet all of the reasonable demands of local groups.

12. Many Parent-Teacher Associations will take on the characteristics of citizens' committees in communities where the need for such activities becomes evident.

13. The citizens' committee movement has resulted in improvements to local public schools that otherwise would have been long in coming or that might never have arrived at all.

338 pages. $4.23. Mic 56-1716

A COMPARATIVE STUDY OF OPINIONS CONCERNING EDUCATION OF HIGH SCHOOL NONGRADUATES AND PARENTS OF HIGH SCHOOL NONGRADUATES IN SIX MICHIGAN COMMUNITIES

(Publication No. 16,749)

Walter Chris Heisler, Ed.D.
Michigan State University, 1956

This thesis tested the hypothesis that adults who failed to complete high school, and/or had children who failed to complete high school, had different opinions about education and the school from those who completed high school, and/or had children who completed high school.

This hypothesis was tested in six communities where certain selected questions were asked regarding people's opinions about the following educational areas: value of education, the teacher, the high school program, teaching methods, the elementary school, reasons for leaving school, and the general effectiveness of the school.

Comparisons were made between three distinct pairs of samples: first, a sample representing all adults who finished high school was compared to a sample of adults who failed to complete high school; second, a selected sample of high school graduates was compared to a selected sample of drop-outs who had similar characteristics in sex, age, occupation, place of residence, and income; and third, a sample of selected adults who had had no children drop out of high school was compared to a selected sample of adults who had had at least one child drop out and who also had similar characteristics in sex, age, occupation, place of residence, and income.

The findings showed that, although there were substantial differences between the drop-outs and graduates with respect to the socioeconomic variables investigated, the differences between the drop-outs and the graduates in all three samples with respect to opinions about education were relatively small. The most significant difference between the two groups was in the larger number of "don't know" responses among the drop-outs.

The data showed, among other things, that drop-outs and parents of drop-outs were somewhat more inclined than graduates: (1) to favor having more children acquire a secondary and college education; (2) to fail to see the necessity for more money for the school; (3) to favor hiring more men teachers in English; (4) to be less concerned about low salaries for teachers; (5) to prefer a subject-matter centered school program as opposed to a project centered program; (6) to desire less freedom for children in school affairs; (7) to favor raising the compulsory limit for school attendance; and (8) to feel that children did not receive enough individual attention.

There was no statistically significant difference between the selected drop-out and the graduate samples with respect to: (1) recognition of the need for special help for slow learners; (2) attitudes about homework; (3) revision of the curriculum; (4) extracurricular activities; (5) the elementary school; and (6) citizenship training.

Adults who failed to complete high school predominantly said they quit for economic reasons; however, the reasons given by parents for their children's failure to complete school usually indicated a general dislike for school.

The findings seem to imply that school personnel need to recognize that they are responsible for the fact that so many students fail to complete high school: first, because they have not developed adequate interpersonal relationships with the potential drop-out or his parent; and second, because they have not developed the kind of school program (in cooperation with parents) which will more adequately serve the needs of all youth.

366 pages. $4.58. Mic 56-1717

THE ROLE OF THE SUPERINTENDENT OF PUBLIC INSTRUCTION IN TENURE APPEALS

(Publication No. 16,517)

Harry L. Kohn, Ph.D.
University of Pittsburgh, 1956

This is a study of the role of the Superintendent of Public Instruction in Pennsylvania in teacher-tenure appeals. The study presents the statutory and interpreted authority of the Superintendent in his role as a quasi-judicial officer, analyzes his interpretations as to the purposes of the Tenure Act and the factors considered by him in his opinions, discusses the principles of law in his

nonappealed rulings, and compares his appealed rulings with those of the courts. The principal sources used in the discovery of these data are the official opinions of the Superintendent in tenure appeals and the case records of the appellate courts in Pennsylvania since 1939.

The study of the role of the Superintendent falls into four major areas for classification. These areas are:

1. The authority of the Superintendent in tenure appeals and the exercise of that authority. 2. The interpretations as to the purposes of the Tenure Act and the factors considered by the Superintendent in his opinions. 3. The opinions and rulings by the Superintendent that were not appealed to the courts. 4. The comparison of the opinions and rulings by the Superintendent and the courts.

The review of the opinions and decisions shows the importance of the Superintendent in fulfilling his intended role of reducing the amount of court litigation in tenure cases and/or reviewing tenure appeals from an educational view point. The analysis of the nonappealed opinions and the comparison of the appealed rulings present the non-court and court legal principles of tenure.

Conclusions reached from the study are:

1. The authority of the Superintendent to review tenure appeals is interpreted strictly. The absence of statutory provisions granting authority is a limitation of his authority. 2. The Tenure Act does not authorize the Superintendent to substitute his jurisdiction over the discretion of school boards to manage their affairs. 3. The Superintendent of Public Instruction assures professional employes a fair, impartial, and unbiased hearing before the school board. 4. Boards are confused between the charges of "persistent and wilful violation of the school laws" and "persistent negligence"; a dismissal based on one is generally equivalent to a dismissal based on the other. 5. Persons aggrieved by suspensions and temporary professional employees have no right of appeal to the Superintendent. 6. Salary opportunities are the major factors in determining demotions in type of position. 7. The Superintendent upheld the boards' rights to make rules and regulations for their schools, and employees' failure to obey those reasonably enforced rules constitutes persistent negligence. 8. Although "unsatisfactory" ratings are not conclusive evidence in dismissals based on incompetency, the Superintendent would not agree to a dismissal when the rating was satisfactory. 9. Incompetency includes lack of substantive knowledge as well as physical incapacity. Ratings are necessary when the physically incompetent teacher remains in the classroom; unnecessary when pregnancy renders the teacher physically incompetent. 10. The Superintendent has never sustained a charge of immorality and cruelty. 11. Boards are confused by the procedure in tenure disputes. The boards lost 25 appeals because of faulty procedural practices. 12. The rulings of the Superintendent were accepted and/or affirmed in 79 of the 92 or in 85.9 per cent of the appeals; however, his 39 appealed rulings were reversed 13 times or 33.3 per cent. 13. The higher appellate courts favored the school boards in 16 of their 19 rulings. 14. There was general agreement between the Superintendent and the courts on the legal principles involved in the tenure appeals; the reversals were based mainly on: the Superintendent deciding appeals on procedure, different interpretations on the reasonableness of boards' enforcing their rules, pregnancy as cause for dismissal, and demotions in type of position.

310 pages. $3.88. Mic 56-1718

A STUDY OF THE SUPPLEMENTAL INCOMES OF WOMEN TEACHERS IN THE PUBLIC SCHOOLS OF ALLEGHENY COUNTY, PENNSYLVANIA

(Publication No. 16,519)

Frank McClay Naylor, Ed.D.
University of Pittsburgh, 1956

The purpose of this normative survey was to determine the extent and nature of, and the need for and effects of the supplemental incomes of women teachers in the public schools of Allegheny County, Pennsylvania, for the school year 1953-1954 and the summer vacation of 1954. "Supplemental income" included income from: part-time employment during the school year, employment during the summer vacation, operation of own business, investments, and other sources. Extraprofessional salary and husband's income were not considered as "supplemental income".

The instrument utilized in the study was sent to every fourth woman teacher in the public schools of the County. Of this sample, 1,118 (75.7 per cent) returned usable questionnaires. Business machines were used in the tabulation and cross-tabulation of item-responses of the completed questionnaires. The interpretation of the data basically involved: the number of item-responses, the percentage of item-responses, and measures of central tendency where applicable.

The typical teacher of the study was unmarried, over 43 years of age, had at least four years of college training, had taught 16 years, and had received a contractual salary of $4,069. Pay for extraprofessional duties increased this median salary to $4,108. Teachers with supplemental incomes had a dependency load of 1.2 persons, .1 person more than those not supplementing. Median spouse income was $4,371.

One-fourth of the respondents reported supplemental incomes of some nature, investment incomes being most common. The median total supplemental income was $363. The median family-unit income was $4,739. More than two-fifths of the group reported no income other than contractual salary; fewer than one-fifth reported over half of their family income from noncontractual sources. The median number of hours worked during the school term was five; the median number of days worked during the summer vacation was 31.5. Most of the work was in clerical and sales occupations; professional and managerial occupations ranked second.

Economic necessity was the most frequently reported reason for supplemental working, followed by liking for the work, maintenance or improvement of standard of living, avocational interest, and acquisition of luxuries. Most frequently mentioned reasons for not supplementing were demands of teaching and homemaking duties. The most frequent utilization of supplemental incomes was for current expenses. Less was spent by fewer teachers for professional advancement than for any other broad expenditure.

For a median estimated true professional salary of $5,446, the majority was willing to give up supplemental work but strongly opposed extension of the school year.

Opinions as to effects of supplemental working varied. The majority of those actively working to augment teaching incomes agreed that supplemental work had positive personal effects upon classroom effectiveness, self-respect, community prestige, enjoyment of home life, and

health. However, the minorities reporting harmful effects of supplemental working pose a serious problem.

Although few of the total group agreed that demands of the outside job were more imperative, the majority believed that, if either job were slighted, it would be that of teaching. Agreed that valuable knowledge of the world of work was gained by nonprofessional supplementing, the majority disbelieved that adult contacts or vocational experience sufficiently justified outside working. Most of the respondents believed there was more economic justification for male teachers to engage in supplemental work. They did not agree that school boards should attempt at present to regulate or control part-time employment. They did not feel that supplemental working created an unwholesome climate of competition among teachers; however, they believed that the profession lost status when its members engaged in outside work. The overall effect of supplemental working, the majority agreed, was undesirable. 261 pages. $3.26. Mic 56-1719

LEGISLATIVE DEVELOPMENTS IN SCHOOL DISTRICT ORGANIZATION IN PENNSYLVANIA

(Publication No. 16,520)

Robert Francis Nicely, Ed.D.
University of Pittsburgh, 1956

An analysis of the statutes enacted by the various legislatures during the past 200 years, with respect to school district organization, was undertaken in order to determine the legislative developments in this area. The study was divided into five elements, each typifying a significant era in the legislative history of the commonwealth. The first period was characterized by complete parental responsibility for the establishment of provisions for the education of their youth. Following came a time when individual districts, shortly after their inception as such, were granted great leeway in the solution of their educational problems. A cooperative period in which school districts almost reached their maximum in number followed. Intensification of central control characterized the next to last period which subsequently deals with the combination of administrative units and attendance areas.

During the past decade, a tremendous upsurge in district reorganization activity has been experienced in Pennsylvania, brought about largely by the enactment of legislation which provided financial inducements for the joint use of facilities, either by the jointure, merger, or union method. As of November 18, 1955, there were 472 Joint Boards, representing 1804 school districts with an enrollment well exceeding half a million pupils, and representing 73.2 per cent of the total number of school districts in the Commonwealth. At the same time, there were 68 Union or Merged Districts in operation. These represent 175 former districts with a school population of approximately 60,000 pupils.

The original intent of the "jointure legislation" was to enable adjoining districts to establish and operate schools near their borders on a cooperative basis when such schools could serve parts of two districts to mutual advantage. In recent years, however, the joint school provision has been employed more and more by smaller school districts as a means of creating larger units of administration through joint operation of all the schools in an area comprising several school districts. The authority to establish and operate joint schools is no longer limited to districts which are adjoining but applies to any two or more school districts.

As the benefits of reorganization become more apparent, it would seem logical to assume that many of the districts now engaged in the joint operation of schools may desire to unify further the school system by forming a union or merged school district.

Educational leaders, state, county, and district superintendents, teachers and their professional organization, and school directors and their organizations have played a significant role in shaping the course of legislation relative to school district organization and the total educational program. The Free Public School Act, the Code of 1911, and, more recently, Senate Bill 769, have been the results of the efforts of outstanding leaders with educational vision. This most recent, and perhaps most significant, proposal to reach legislative consideration, is the result of several years of intensive research. The Committee of 27 who developed the educational plan contained in Senate Bill 769 is representative of the best educational thinking of the day but it lacks legislative jurisdiction.

The exercise of state control, through an equalization program of providing state funds, has broadened the educational opportunities for the pupils of all districts within the Commonwealth. The dual system of school administration in Pennsylvania needs to be examined in the light of present-day needs. The establishment of a service agency on a regional basis would fulfill a great need in school district organization in Pennsylvania.

A sequel to this study should seek to determine the real cause for the apparent failure of numerous school districts to agree on a method of using their facilities jointly.

173 pages. $2.16. Mic 56-1720

INSERVICE EDUCATION PRACTICES IN SELECTED SECONDARY SCHOOLS AND THEIR IMPLICATIONS FOR THE IMPROVEMENT OF TEACHING FACULTIES IN THE PHILIPPINES

(Publication No. 16,561)

Patrocinio Sison Ocampo, Ph.D.
University of Minnesota, 1956

Adviser: Dr. Robert J. Keller

I. PURPOSE

The purpose of this study is to determine the nature and usefulness of certain inservice education practices in selected secondary schools in the area served by the North Central Association. Teachers and administrators in these schools were asked to identify and describe promising practices used by them to improve teaching faculties. Findings have been interpreted in terms of implications for inservice education in the Philippines.

II. PROCEDURE

The survey form of study was employed with checklist-type questions organized in a sixteen-page questionnaire.

Only information which could be gathered by mail response was secured.

The inservice education techniques included in the survey were selected from those frequently recommended by education specialists or frequently discussed in professional publications on supervision. Major techniques included were faculty professional meetings, classroom visitation, professional workshops, self-study and research.

Member schools of the North Central Association which have developed promising programs of inservice education were identified by state committee members. Administrators of these schools in turn classified faculty members into those which have made the "most" and "least" professional growth in the past three years. Respondents were classified according to position (teacher or administrator), source of support (public or private), size of enrollment (large, medium, or small) and category of professional growth. Representativeness of response was tested and adjudged to be adequate although the total response among teachers was 45.9 per cent and 66.2 per cent from principals.

Detailed findings were obtained by cross classification of responses in terms of the groups enumerated above. Punched card procedures were employed. Suitable statistical tests determined the significance of differences in response among the several groups.

III. CONCLUSIONS AND IMPLICATIONS

1. Inservice programs should be cooperatively planned and organized by the principal and teachers in the local school. The recommendation is consequently made that teachers be aroused to a greater awareness of their personal responsibility to grow professionally through active participation in inservice education activities.

2. Good leadership is essential in the development of effective inservice education programs if cooperative working relationships are to emerge. The recommendation is made that teachers be encouraged to take greater responsibility for meeting the educational needs of students in their local schools. This grass roots approach is particularly to be encouraged in the highly centralized Philippine educational system.

3. In developing a program of inservice education a large number and variety of techniques will be found helpful and acceptable to teachers and administrators. Among techniques most widely accepted as valuable by teachers and administrators in this study were: attendance at meetings of professional association, professional readings, attendance at State Education Association and summer school attendance. This supports the recommendation that varied inservice education activities be employed in secondary schools to meet the individual needs of teachers.

4. Very little use is made of self-study, research projects and the "Cooperative Study of Secondary School Standards" (Evaluative Criteria). More extensive use of self-study on problems of the individual school is recommended together with greater emphasis upon educational research in the pre-service and inservice education of Filipino teachers.

5. Since inservice education is needed by all teachers, the recommendation is made that employing officials include provisions in teaching contracts identifying inservice activities as a part of the teacher's responsibilities and including salary increments which motivate participation. Salaries of Filipino teachers must be raised to levels which will attract the most competent young people to teaching.

6. More than nine-tenths of the teacher respondents in this study were teaching in the field of their college major. Since this is not true in the Philippines, the recommendation is made that teacher education institutions enlarge their college offerings and endorse the University of the Philippines' pattern of two integrated major fields instead of one major and one minor.

378 pages. $4.73. Mic 56-1721

A SURVEY OF ACTIONS TAKEN ON RECOMMENDATIONS RESULTING FROM THE EVALUATIONS OF THE PITTSBURGH PUBLIC SECONDARY SCHOOLS

(Publication No. 16,522)

John Edward Ricart, Jr., Ed.D.
University of Pittsburgh, 1956

The purpose of this study was to determine the effect of recommendations resulting from the evaluations of the 12 comprehensive Pittsburgh public secondary schools. Through use of the Evaluative Criteria (1940 Edition) visiting committees evaluating the schools in the period from December, 1946, to April, 1951, made 746 recommendations intended for the improvement of those schools. The effect of the evaluation recommendations was determined in this study by an analysis of the actions taken, procedures or techniques used, and evidences of attainment.

Information pertinent to each recommendation was obtained from the high school principals by means of the research interview technique. The recommendations of all schools were grouped according to their respective sections in the Evaluative Criteria: Curriculum and Courses of Study; Pupil Activity Program; Library Service; Guidance Service; Instruction; Outcomes of the Educational Program; School Staff; School Plant; and School Administration. For purposes of analysis the recommendations of each section were divided into categories, according to their underlying objectives. Tables were constructed to indicate frequency and per cent of occurrence, actions taken, and procedures or techniques used to carry out the recommendations.

It was found that compliant action was reported on 70.8 per cent of the recommendations with 46.0 per cent now in process of being carried out and action completed on 24.8 per cent. The schools postponed action on 21.0 per cent of the recommendations, and 8.2 per cent were rejected by the schools as invalid. To carry out the recommendations the method used in the majority of cases was the technique of individual action. The central administration directors or supervisors and the school principals were the persons primarily responsible for carrying out the complying action although frequent use was made of the classroom teachers, counselors, and activity directors. Group procedures were employed in 61 instances to accomplish the required action.

Examination of the 51 categories under which the recommendations were analyzed revealed that the recommendations may be combined into six area classifications that crossed the section lines of the Evaluative Criteria. A summary of evidences of attainment was presented in the six areas; (1) teaching methods and procedures; (2) school plant; (3) program of studies; (4) organization and administration; (5) school staff; and (6) guidance service.

The following conclusions are a result of the study.

1. The evaluations have been an effective force in stimulating the schools to a program of continuous self-improvement.
2. The schools expressed confidence in the evaluation procedure.
3. Those directly responsible for the administration of the schools approved the recommendations intended for the improvement of the schools.
4. Improvements in teaching methods and procedures were evident.
5. Many imperative alterations, expansions, and remodelings of rooms or parts of the school plant have been accomplished.
6. The schools have become conscious of the need for adaptation, addition, extension, and improvement of the program of studies.
7. Organization and administration recommendations emphasized several important city-wide developments.
8. Confidence was expressed in the quality and professional preparation of the staff members of the schools evaluated.
9. Guidance service recommendations have implemented the development of a more adequate program.
10. Recommendations were postponed primarily because of insufficient funds, personnel needs, and lack of facilities. Recommendations thought invalid were rejected primarily because they were contrary to the educational philosophy of the schools or were thought not feasible.

381 pages. $4.76. Mic 56-1722

EDUCATION, ADULT

ADULT EDUCATION IN SCANDINAVIA: A STUDY IN DEMOCRACY AND ITS MEANING FOR CONTINUING EDUCATION IN THE UNITED STATES, ESPECIALLY AS IT PERTAINS TO THE COMMUNITY COLLEGE

(Publication No. 16,362)

Howard Dene Southwood, Ed.D.
The University of Florida, 1956

The underlying theme of this study of the development of voluntary, adult education in Scandinavia has been an effort to determine whether it has any meaning for adult education in the United States. More specifically the study was undertaken in an attempt to find answers to these questions: (1) how does adult education in Scandinavia meet the people's needs for enlightenment, that is, how does it provide a means of making the democratic process effective and of giving to the people the full use of their mass intelligence in determining their own destiny, (2) what other aims are encompassed in the mission of Scandinavian adult education, (3) what are the principal organizational approaches and relevant factors in the more successful adult education programs in Scandinavia, and (4) what are the implications of Scandinavian adult education for adult education in the United States, particularly that under the auspices of the community college?

These objectives were accomplished by study in the Scandinavian countries, through interviews, observations, reading, and participation in the adult education programs.

The primary considerations of the study have been limited to the two main voluntary, adult, educational activities: the residential schools, known generally as the folkehøjskoler; and the nonresidential schools which manifest themselves largely in the aftenskoler in Denmark, the studiegrupper in Norway, and the studiecirkeler in Sweden.

Adult education in Scandinavia has evolved largely as an attempt to solve satisfactorily a multiform crisis in organized social life. In all of the adult programs the purpose was the same: to encourage social, moral, and intellectual responsibility in a democratic society, and to educate for a higher standard of national and world citizenship.

Efforts toward the achievement of these goals have been made through extensive development of adult education facilities. Increasingly liberal state aid has largely eliminated economic and geographic considerations as barriers to continuing education. The curriculum is built around the changing needs and desires of the people, affording democratic environments for the development of aesthetic, physical, and mental abilities; personality; self-determination; and creativity.

Upon completion of courses of study, pupils are encouraged to return to their farms, crafts, or trades with a finer feeling for life. In Scandinavia education is thought of as a means of bettering oneself rather than of improving one's social or economic position. This approach to education has fostered the attitude that work is honorable; and has culminated in the high standard of living, general contentment, and psychological well-being of the Scandinavian people.

Adult education in Scandinavia has evolved to the point where it is no mere function of society, but has produced a segment of society which is itself educative. This has come about largely through voluntary, adult education programs which are uniquely Scandinavian. An analysis of these activities leads to a number of conclusions which are significant for the furtherance of adult education in the United States, especially through their reinforcement of the community college concept.

These conclusions indicate that because of their close contact with the community and community needs, their low cost to participants, their relatively smaller size and broader curricular offerings, their freedom from traditional weaknesses, the philosophy behind their raison d'etre, and in the light of the findings of this study of adult

education in Scandinavia, the people's community colleges are well suited for the development and extension of adult education in the United States.

164 pages. $2.08. Mic 56-1723

EDUCATION, HISTORY

THE CHANGING FUNCTIONS OF THE UNIVERSITY OF CONNECTICUT

(Publication No. 16,583)

Ruth Bosworth, Ph.D.
New York University, 1956

The University of Connecticut had five names in the course of its development: Storrs Agricultural School (1881), Storrs Agricultural College (1893), Connecticut Agricultural College (1900), Connecticut State College (1933), and University of Connecticut (1939). The problem was to identify the purposes under each of these names; to discover whether there were identifiable trends in these purposes; and to determine whether there were interested groups in addition to the legislative group and if so, what their opinions were and whether it is likely that such groups were associated with the major changes of purpose.

In 1881, offering instruction in agriculture was the dominant aim, and this purpose was maintained. However, additional areas of study were gradually introduced—Home Economics, Engineering, Education, and arts and science courses—and by the end of the third period, despite the fact that primary emphasis on research and extension work was in agriculture, this general field no longer held undisputed sway. Next came Arts and Science, Business, Nursing, Pharmacy, Physical Education, and special schools of Insurance, Law, and Social Work, together with development of the graduate program.

Purposes in addition to those represented by academic offerings also were subject to development. During the Storrs Agricultural School period, beyond the basic operating aim, there were few purposes unrelated to fundamental student needs. Two exceptions were experiment work and short on-campus courses. In the next period, attention to student development broadened, and first glimmerings of service to the state appeared. Under the Connecticut Agricultural College, work on all the above-mentioned aims was intensified, while public service and scholarship received special emphasis. After 1933, intensification continued and the chief new development was an offer to teach any subject needed by Connecticut citizens.

State legislation was vital to all of these changes. A total of 509 bills, resolutions, and petitions was introduced and only half of them met with legislative approval. However, it was found that 153 of the measures which did not succeed were definitely related to later successful legislation.

Among the influences on this state legislation was federal legislation concerned with land-grant colleges. Groups within the state which were also found to have influence on the actions of the state legislature may be classified as follows: those representing agricultural interests, those representing industrial interests, two Hartford newspapers, and the alumni.

The Board of Agriculture and the State Grange sponsored the inception and early development of the Storrs Agricultural School. During the second period, the interest of the latter continued, and the two newspapers took opposing sides on the question of changing the name to Storrs Agricultural College. Also, one group, organized for the purpose of developing a specific area in agriculture, advocated a special project to be administered by the College. In the Connecticut Agricultural College period, five such groups were following similar programs, while the Grange and Farm Bureau called for further agricultural emphasis. The alumni were concerned for the prestige of their institution, but the industrial groups tended to obstruct development. During the next period, agricultural-group and alumni activity continued in approximately the same manner as before, and both newspapers supported the name change, while the industrial groups were less influential than they had been. The University of Connecticut period differed from the others in that although specialized groups continued to promote their own projects, they were also active in supporting general measures affecting the University.

In summary, between each name change the groups influenced growth, which in turn made the succeeding change a possibility capable of realization.

323 pages. $4.04. Mic 56-1724

SILAS SADLER PACKARD, PIONEER IN AMERICAN BUSINESS EDUCATION

(Publication No. 13,599)

Thomas L. Cahalan, Ph.D.
New York University, 1955

Chairman: Professor William W. Brickman

The Problem

The problem was to determine the extent to which the major educational ideas of Silas Sadler Packard, expressed in his writings and realized in the educational practices of Packard Junior College, have been reflected in selected educational writings of the period 1858 to 1898.

Background of the Problem

Packard's Business College existed, under several names, from 1858 to 1954. Its development took place against an historical background of sweeping changes in the national life. Foreign immigration and industrial revolution produced profound changes to which the schools had to make complex adjustments. During the last half of the century numerous efforts were made to employ the ideas of Pestalozzi, Herbart, and Froebel in the developing national system of education. Business education was especially affected by the increased industrialization.

Importance of the Problem

No studies of the relationship investigated had previously been made, nor had the life of Packard, which even a cursory examination indicates to have been of unparalleled impact on business education, been formally studied.

It was considered desirable to determine whether or not the success of a school is due to adjustment to change. The formula that led to survival for nearly a hundred years may be useful to existing schools and to the community at large. Moreover, Packard was an important factor in the movement of women into business. This study shows their debt to Packard and his relation to their training for business.

Procedure.

All of Packard's surviving writings were read and summarized. Particular care was used to extract in detail his educational ideas and practices. This material was classified under topic headings. Then all of the existing reports of the business educators' organizations were read, and the ideas of the outstanding men analyzed. Comparison was made of Packard's ideas and those of the other business educators. Next, an examination was made of the ideas of general educators on topics on which Packard had expressed opinions, and a comparison of their ideas made.

Findings and Conclusions

The known facts of Packard's life, 1826-1898, were compiled, and a partial biography presented. Various facets of Packard's career were separately analyzed. Considered as a writer, publisher, and editor, Packard was moderately successful. He edited and published three magazines, wrote widely for newspapers and magazines, and published a highly successful series of textbooks in several areas of business education.

The distinctive features of Packard's plan of instruction, his pupil rating system, his training for girls, and his extra-curricular program were examined. Packard believed strongly in practical education, in the dignity of business education, and in the education of women for business. He considered the primary aims of education the development of strong moral character, of cultural background, and adjustability. The teacher must know and love his pupils, must supply proper motivation, yet education is essentially a process of self-training. The eyes of the pupil are the most effective avenue of learning, but the most significant factor is the teacher. Packard considered business training as professional as medical training, and as terminal. He believed that it must adjust to the needs of the community; that it should emphasize its specialties by limiting its curriculum; that it should train women on same basis as men.

Packard's educational thinking was far in advance of his colleagues in business education. He drew many ideas from Mann and Barnard, not adopting them in toto, but modifying them to suit his purpose. He was in advance of Mann and Barnard in respect to his views on business education and the education of women. He was more progressive than Harris and less so than Parker. His views were eclectic, moderate, nicely adjusted to the demands of his time.

His participation in the various business educators' organization was explored, and a brief history of those organizations included. His views as a private person were also examined.

Finally an estimated measure of his influence was made, with attention to his effect on education, the community, and his associates.

355 pages. $4.44. Mic 56-1725

A HISTORY OF THE MUNICIPAL RECREATION DEPARTMENT OF THE DISTRICT OF COLUMBIA (1790-1954)

(Publication No. 16,636)

Bernard Semple Fortner, Ed.D.
University of Maryland, 1956

Supervisor: Dr. Ellen E. Harvey

This study was concerned with an investigation of the history of the Municipal Recreation Department of the District of Columbia from 1790 through the year 1954, considering the general objectives of (1) local leadership; (2) public recreation agencies; (3) personnel; (4) facilities and equipment; (5) the public recreation program; (6) the relationship of the public recreation movement in Washington, D. C., to the movement in the United States; and (7) predictions for the future.

Basic data was largely gathered through the library and documentary technique; the interview technique and the correspondence technique were employed as suppletory methods. Scientific historical research methodology was followed, and the chronological-topic approach was adopted in order to present the basic data in a fluid, lucid, and coherent manner.

The public recreation movement in the District of Columbia evolved through the three major stages of (1) Conception, (2) Coordination, and (3) Consolidation. There was a lack of supervised public recreation program in Washington, D. C., until the beginning of the twentieth century when the formative period (1900-1934) began with the establishing of the playground in the back yard of the Neighborhood House, with the establishment of the "pipe-yard" playground, and with the organization of local leaders into the Public Playgrounds Committee. Other significant inception events occurred in 1906 when Congressional legislation first provided for "supervision;" in 1911 when the Department of Playgrounds was established; in 1915 when Congressional legislation first enabled the use for recreational purposes of public school buildings, which in 1917 developed into the Community Center Department; and in 1929 when the local recreation movement was first provided with a permanent basis by the drafting of a Recreation System Plan for the District of Columbia. The period of coordination (1935-1941) began with the appointment of a Coordinator of Recreation, and, even after the Community Center Department and the Department of Playgrounds were amalgamated in 1939 into the Community Center and Playgrounds Department, there occurred considerable coordination efforts by all public recreation agencies. It was on May 29, 1942, that the passage of Public Law 534 began the consolidation period (1942-1954) by creating the District of Columbia Recreation Board which established the Municipal Recreation Department of the District of Columbia. There remained the continued operation of certain active recreational facilities through concessionaire operation under the National Capital Parks Office, but much progress was accomplished during the consolidation period, especially in the physical improvement of recreational facilities, the increased availability of recreation to the public, the improvement of personnel standards, and an increased acceptance of the leisure concept.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

Many of the early developments in the local public recreation movement continued to be significant as of 1954. Many problems of the early development likewise continued to be problems. Many recurring patterns of events have been evident in the history of the local public recreation movement.

The local public recreation movement generally has paralleled the public recreation movement in the United States. In the future the local movement will probably continue to be similar to that of the nation; it will evolve through a crystalized consolidation into a period of progressive "Continuation." 618 pages. $7.73. Mic 56-1726

EDUCATION, PHYSICAL

THE DEVELOPMENT OF A PROFESSIONAL CURRICULUM IN PHYSICAL EDUCATION FOR HAMPTON INSTITUTE IN ITS REORGANIZED PROGRAM OF TEACHER PREPARATION

(Publication No. 16,618)

Herman Newman Neilson, Ed.D.
New York University, 1956

Chairman: Professor Leonard A. Larson

The Problem

The problem was to develop a four-year undergraduate professional curriculum in physical education for men and women of Hampton Institute majoring in physical education.

Procedure

Pertinent data were determined through documentary survey of professional literature in teacher education, including reports of committees, commissions and conferences; questionnaire surveys, correspondence, and personal interviews. These data were organized for treatment according to their relationship to the following four sub-problems: (1) the national, state, and local influences which affect the teacher education curriculum in physical education at Hampton Institute, (2) the current trends in teacher education and the implications for the professional curriculum in physical education, (3) the evaluation of the existing teacher education curriculum as determined by the application of professional standards, and (4) the development of the curriculum for Hampton Institute based on criteria derived from the influences, trends, and evaluation.

Data relating to national, state, and local influences obtained through documentary surveys, interviews, and questionnaire study were analyzed and statements of facts which had implications for the curriculum were pointed out.

Data relating to current trends in teacher education obtained through documentary survey were analyzed and summarized. Statements of findings evolved from items of common agreement according to the evidence obtained. Conclusions were drawn from these data which had implications for the professional curriculum for Hampton Institute.

Data relating to the evaluation of the existing curriculum were determined through an application of an instrument of appraisal. These data were summarized and conclusions drawn which had implications for the curriculum of Hampton Institute.

Data relating to establishing the curriculum were derived through the research. Criteria and the curriculum were developed which were approved by key administrators of the college.

Results

Findings relating to national, state, and local influences which affected the development of the curriculum provided succinct controlling factors in terms of bases for professional study; operational principles; knowledge of field conditions; teacher certification requirements; administrative policies of Hampton Institute; physical and social characteristics of the local community; and accreditation of the college. Data obtained indicated that these influences were of such nature as to facilitate the development of a professionally acceptable program.

Findings relating to current trends in teacher education revealed significant contemporary tendencies such as general education as a base for professional preparation; block-survey type courses; five-year period of undergraduate preparation; health, physical education and recreation as separate fields; personal-social-professional competency as criterion of curriculum goals; rigorous screening of candidates; emphasis on improvement of curricula; concern for adequate facilities and equipment; the community as a laboratory for teacher preparation; and concern for educational aspects of athletics.

Findings relating to the evaluation of the existing curriculum showed that the weaknesses revealed could be eradicated in the proposed curriculum.

Fifteen criteria established by summary of materials secured from the research were matched against provisions of the proposed curriculum. The curriculum was found adequate in terms of these criteria.

Conclusions

The interpretation of these findings indicate that the following conclusions may be drawn in regard to the professional physical education curriculum at Hampton Institute:

(1) That national, state, and local influences indicated in the research constitute controlling factors.

(2) That desirable contemporary trends in teacher education should be reflected in curriculum provisions.

(3) That flexibility of organization should be retained to afford continuous evaluation and revision in the light of changing societal and professional aspects.

(4) That curriculum experiences should enable the development of socially-professionally competent persons.

388 pages. $4.85. Mic 56-1727

THE IDENTIFICATION OF PRINCIPLES RELATED TO THE EDUCATION AND TRAINING OF THE INDIVIDUAL FOR MORE EFFICIENT NEUROMUSCULAR FUNCTION

(Publication No. 16,619)

Harry Gordon Oestreich, Ed.D.
New York University, 1956

The objective of this study is to identify principles which are related to the education and training of the individual for more efficient neuromuscular function; to determine the methods and techniques which are implied by these principles for physical education procedures; and to determine types and designs of research that are needed to test the projected hypotheses and procedures.

Within the framework of the assumption that the basis for an adequate methodology can be found in existing knowledge, the following sciences concerned with human behavior were investigated in a search for evidence from which principles could be identified: anatomy, physiology, kinesiology, neurology, psychology, educational psychology, education, physics, and mechanics.

The professional thinking relative to body mechanics, particularly in the area of neuromuscular function, is characterized by considerable controversy and confusion. The factors that promoted this fluid and indecisive situation illustrate the need for a broad evaluation and integration of the facts and principles from the various sciences applicable to the function of movement.

A survey of the literature related to the problem of body mechanics revealed the lack of a basic philosophy in this field of education. In general, the research that was carried on was atomistic and segmental with little effort devoted to the coordination and integration of this body of diverse data into related units. Experimentation in the area of the application of mechanics of movement stimulated a professional interest in methods. Direct and indirect teaching innovations, introduced in the area of body mechanics, challenged certain basic tenets of physical education; and a realistic and open-minded appraisal of the new techniques seemed to require an objective search for common grounds of agreement from which to launch testing procedures.

An extensive search into the related sciences resulted in the identification of seventy-nine principles which pertain to the education and training of the individual for more efficient neuromuscular function. These principles were classified according to their relationship to movement and to education.

The fifty-eight principles identified to describe the characteristics of movement fall into three related groups: (a) Principle of Physical Phenomenon, (b) Principles of Structure, and (c) Principles of Function.

The twenty-one principles identified in the area of education are classified under two headings: (a) Broad Educational Principles and (b) Specific Educational Principles.

Interpreting the implications of the identified principles to methodology, in general, resulted in the development of seven criteria for the evaluation of methods to determine their appropriateness for utility in the area of neuromuscular function.

Five procedures were evaluated for their appropriateness as physical education methods to educate and train the individual for more efficient neuromuscular function: namely, medical procedures, mechanical appliances, psychological procedures, directed activities, and indirect procedures.

The evaluation seems to indicate the following:

1. Directed activity, as an educational procedure, is highly adapted to group practice. It is an appropriate method for improving the general physical vitality and organic vigor of the individual. Directed activity is especially effective for the perfecting of existing patterns of behavior.

2. The directed activity procedure does not appear to attack the elemental neuromuscular patterns of the human activity cycle. An indirect procedure appears to be indicated. Present knowledge seems to suggest that the "mental imagery" technique ranks highest among the indirect methods as an appropriate means for the education and training of the individual for more efficient neuromuscular function.

The types and designs of research needed to test these hypotheses and projected procedures were treated under three categories of related problems: (a) Mechanics of Movement, (b) Characteristics of Movement, and (c) Mechanism of Movement. 414 pages. $5.18. Mic 56-1728

EDUCATION, PSYCHOLOGY

AN EXPERIMENTAL INVESTIGATION OF GROUP COUNSELING WITH FRESHMEN IN A WOMAN'S COLLEGE

(Publication No. 16,581)

Robert Lee Anderson, Ph.D.
New York University, 1956

The purpose of this study is to evaluate the effectiveness of a program of group counseling with freshmen in a woman's college as a method of helping students to deal with their problems and as a method of minimizing academic casualities, while promoting academic achievement. Since psychotherapists and guidance workers have found it economical and practical to use group methods in dealing with their respective clients, this investigation was designed to test how fruitful counseling with groups of normal students can be in helping them to solve such personal problems as lack of friends, academic adjustment, courtship and marriage, and other matters of such personal concern to the individual that he might seek the help of a professional counselor. In addition, it evaluates the effectiveness of group counseling as a means of enhancing academic achievement.

Three separate methods and two different criteria were used in making the evaluation. The subjects were sixty college freshmen women. Thirty subjects made up the experimental group and participated in eight group counseling sessions. The other subjects served as a control group and continued in the normal college routine. The equivalence of the two groups prior to counseling was established by statistical analysis testing for significant differences in

the means of the two groups on three variables: intellective factors, non-intellective factors, and previous academic performance. The problem areas of most concern to the subjects were revealed by the tests of non-intellective factors. The client-opinion method was used to determine how effectively group counseling facilitated the solution of the students' problems. Rating scales, administered to the experimental group immediately following the last counseling session and again one year later, were used to obtain the information. The evaluation of group counseling as a means of enhancing academic performance was based on statistical analysis of the subjects academic grades. The comparison of academic performance within the experimental group before and after counseling served as another method of evaluation. The third method involved the comparison of the academic performance of the control and experimental groups for significant differences in average performance at three different times.

The results of the experiment are conflicting. On the one hand, the counseled subjects evaluating the counseling experience indicated that they found the experience helpful in solving their problems. The most effective work was done in the areas of adjustment to college work and social adjustment, both of which were among the most prominent problem areas for this group. On the other hand, no significant differences were found either within the experimental group or between the experimental and the control groups in terms of a tendency to improve academic performance.

Three conclusions appear to be justified from an analysis of the experimental results. First, the problem areas in which women college students of freshmen status manifest the most need for counseling are adjustment to college work, social-recreational activities, social-psychological relations, and personal-psychological relations. Second, group counseling of no more than eight sessions can be effective as a method for helping students to deal with these problems. Third, there is no evidence from this study that group counseling with college freshmen helps to minimize the number of academic casualties and maximize academic achievement.

While the study demonstrates a possibility of successful counseling via the group process, further investigation is needed. Additional studies might be done to obtain evidence of better personality integration resulting from such an experience. Further, it would be beneficial to know the personality characteristics of the participants and the optimal number of sessions which would promote successful group counseling. 93 pages. $1.16. Mic 56-1729

A SOCIOMETRIC STUDY OF FRIENDSHIP AND WORK COMPANION CHOICES OF FRATERNITY MEN IN A UNIVERSITY

(Publication No. 16,373)

Harry Thomas Hahn, Ed.D.
Temple University, 1956

This study compared and analyzed the responses of members of high, average and low scholastic fraternities on standardized tests of friendship and work companion choices. Through these comparisons, the study sought to determine: the relationship of sociometric data to certain measures of academic achievement and scholastic aptitude; the extent to which fraternity members differentiated their selections on the two tests; the patterns of social interaction among members of the sophomore, junior and senior classes; and the differences in the social organization of upper classmen in the three fraternity groups.

The research was limited to fifteen of the thirty Greek-letter social fraternities which provide living quarters for their members who attend Lehigh University, Bethlehem, Pennsylvania. It was conducted in the fall of 1954.

Consistency of academic achievement as revealed by fraternity averages and scholastic rank over a two year period was the sole criterion for the selection of the living groups. Five fraternities chosen represented a small group which had maintained high scholarship records, five represented the average or middle group, and five were chosen from those fraternities which had consistently poor scholarship records. This division provided the framework for the comparative studies.

The sociometric choices of individual fraternity members were recorded on the Friendship and Work Companion Tests which were administered on a voluntary basis in the fraternity homes. Of the 450 active members associated with the fifteen fraternities selected, 353 took the tests. The coded information was placed on standardized sociographs. Weighted scores were used for the various levels of choice received by each individual. These scores provided the basis for many of the relationship studies.

Within the limitations of this study, the following conclusions were drawn:

1. Relationship of sociometric data to certain measures of academic achievement and scholastic aptitude.

a. There was a slight positive relationship ($r = .23$ & $.27$) between academic achievement and friendship choices in the high scholastic fraternity group. This relationship ($r = .37$ & $.47$) was higher in this group when the test of work companion choices was the variable.

b. There was a negligible relationship between academic achievement and sociometric choice status on the two tests in the average and low scholastic fraternity groups.

c. The relationship between scholastic aptitude (measured by the American Council of Education Psychological Examination) and sociometric choice on the two tests was negligible in all three fraternity groups.

2. Differentiation in friendship and work companion choices.

a. The high correlation ($r = .75$) between the results of the two sociometric tests minimized the possibility of a significant difference between the choices made for friendships and work companions. There was a trend in all three fraternities to select more men with good grades for work on study assignments than for friendships. However, it was only in the high scholastic fraternity group that this difference was statistically significant.

b. There was no evidence that fraternity men differentiated their selections on the two tests when scholastic aptitude was one of the variables.

3. Patterns of social interaction among members of the sophomore, junior and senior classes.

There was no outstanding evidence of a distinctive pattern of social interaction among the members of the sophomore, junior and senior classes in any one of the three fraternity groups. These characteristics were noted.

a. Approximately one-half of the total acceptances for friendship were given to classmates in all three groups. This was also typical of work companion choices to a slighter degree. A significant exception to this was found in the choices made by sophomores in the high scholastic fraternities. They divided their acceptances equally among fellow sophomores, juniors, and seniors.

b. When academic lines were crossed, seniors and juniors tended to give significantly fewer acceptances to sophomores.

c. The sophomores in the high and low fraternity groups consistently gave more acceptances to upper classmen than they received from them.

d. The rejections given in the three groups tended to be distributed among members of all classes without pattern or design. Thus, rejection did not seem to be related to being a member of a specific class.

4. Social organization of upper classmen in the three fraternity groups.

a. There was a tendency for the members of the high scholastic fraternity group to distribute their first level friendship selections among more of their membership resulting in a greater number of mutual pairs and fewer isolates. However, the differences in the data for the high, average and low scholastic fraternities were not significant enough to infer that there was an appreciable difference in the social organization of their upper classmen.

b. There was a significantly stronger trend for the members of the high scholastic fraternities to distribute their work companion choices among more of their membership than they did in the average and low groups. Thus, the high group had a significantly small number of members who were completely rejected or isolated. It would seem reasonable to infer that the high scholastic fraternities tended to have more members with desirable social status in academic matters than was apparent in the other two groups. 179 pages. $2.24. Mic 56-1730

A STUDY OF THE APPLICATION OF PART IV OF THE DICTIONARY OF OCCUPATIONAL TITLES TO THE OCCUPATIONAL COUNSELING OF HIGH SCHOOL SENIORS

(Publication No. 16,510)

Waide Ardell Haines, Ph.D.
University of Pittsburgh, 1956

The problem presented for investigation in this study was to develop, test, and evaluate a counseling instrument which would utilize the objective system of Entry Occupational Classification of Part IV of the Dictionary of Occupational Titles. For this purpose, the GRAPH OF OCCUPATIONAL POTENTIALS was designed; it applies the classification structure established in Part IV which converts the factors of classification (personal data) into areas of occupational potentials.

The procedure followed was to prepare a GRAPH OF OCCUPATIONAL POTENTIALS for each counselee who was a part of the experiment, plotting the personal data in terms of the occupational potentials denoted in Part IV. The occupational areas were the horizontal headings of the GRAPH form; the personal data, the vertical headings. The horizontal headings included subdivisions of the following occupational areas: professional, clerical-sales, service, agriculture (outdoor), mechanical, and manual. The items of personal data which composed the vertical headings of the GRAPH form included: results of the General Aptitude Test Battery, the California Achievement Tests, and the Kuder Preference Record; best-liked and least-liked high-school subjects; high-school subjects with highest and with lowest grades; school and out-of-school activities; hobbies; work experiences; physical handicaps (if any).

The occupational implications of these personal data, as set forth in Part IV of the D.O.T., were the bases for the preparation of a GRAPH OF OCCUPATIONAL POTENTIALS for each counselee. For example, if a student listed Bookkeeping as the subject liked most in high school, an "x" was placed on this line of the GRAPH in the "computing" (1-X1) and the "recording" (1-X2) vertical columns of the clerical-sales area of the student's GRAPH. Negative information was tabulated in red. After all the personal data were so tabulated, the "x" marks in each vertical column were algebraically added, yielding scores. The columns with the highest scores were considered the areas of greatest potentials.

The individual's GRAPH OF OCCUPATIONAL POTENTIALS was then used in the counseling given to each senior in two graduating classes of Bruce High School, Westernport, Maryland (classes of 1953 and 1954), who became the experimental groups. The class of 1952, whose counseling was not based on the GRAPH, was the control group.

Approximately one year after graduation a follow-up study was made of each of the groups of graduates. The graduates responded to questionnaires which were devised to obtain their satisfactions about the counseling they received. Judgments about the graduates' adjustment were obtained by means of a questionnaire to their employers. The responses made by the control group and the experimental groups were compared. The subjects of the two experimental groups were also classified into high followers (graduates who followed their counseling and entered occupations with high GRAPH scores) and low followers.

It was found that the graduates in the experimental groups expressed a higher degree of satisfaction with their high-school guidance than did the graduates in the control group; the employers of the graduates in the experimental groups rated these employees notably higher than did the employers of the control-group graduates. It was also found that the graduates who entered occupations denoted by high GRAPH scores were more satisfied and were rated higher by their employers than were the low followers.

It was concluded that one of the ways that the classification factors of Part IV of the D.O.T. may be utilized in counseling is through the use of such a device as the GRAPH OF OCCUPATIONAL POTENTIALS and that the relative scores which each counselee makes on the GRAPH may be considered as a noteworthy indication of the counselee's potential success in a given occupational area.

132 pages. $1.65. Mic 56-1731

AN INTER-COMPARISON OF THE QUALITY AND RATE OF THE DEVELOPMENT OF ORAL AND WRITTEN LANGUAGE IN CHILDREN

(Publication No. 16,554)

Lester Edward Harrell, Jr., Ph.D.
University of Minnesota, 1956

Adviser: John E. Anderson

The purpose of the present investigation has been to describe and compare certain aspects of the development of oral and written language expression in school-age children. The total sample consisted of 320 school-age children chosen from the four age levels, 9, 11, 13, and 15 years. In order to control the amount of practice and instruction in writing, no child who was advanced for his age or retarded for his age was chosen; thus only those nine-year-olds in the fourth grade were taken, only eleven-year-olds in the sixth grade, etc. The average age for each group was 9 years and 6.0 months, 11 years and 6.0 months, 13 years and 6.3 months, 15 years and 6.1 months. Of the eighty children at each age level, forty were girls and forty were boys. For each group of forty the proportion of children in each occupational classification was equal to the proportions found for these occupations in the 1940 United States urban population. The IQ of each subject, based on the Otis Quick-Scoring Mental Ability Test was obtained from the records of the Saint Paul, Minnesota public schools.

To collect the written stories, groups of children were shown a short movie and were asked to write the story of the movie. Oral stories were obtained in the same way except that the children were shown a different movie, chosen so as to be similar in content, and were asked to tell their stories individually and privately to the investigator.

The data were analyzed to determine (a) the length of the composition, (b) the length of clauses, (c) the number of unrelated words used in oral stories, (d) the proportion of subordinate clauses to the total number of clauses, (e) the proportion of the various subordinate clause types to the total number of clauses, (f) the position of the subordinate clause in relation to the clause or word they modify or to which they are connected.

In general, the results of the present study concerning these children show that: (a) the length of composition increased with an advance in age, and that oral stories were longer than written at every age level; (b) the length of clauses increased with age in both oral and written stories; (c) the percentage of unrelated words decreased from age 9 1/2 years to 15 1/2 years; (d) children used more subordinate clauses in writing than in speaking, and that this difference increased with an advance in age; (e) children used more adverb and adjective clauses in their writing, but used a greater percentage of noun clauses in speaking; (f) children used a greater percentage of all types of adverbial clauses, with the exception of clauses of time and cause, in their speech; (g) there is a correlation between the subordination index in written stories and chronological age, mental age, IQ, and occupational status; and (h) there is no indication that for any of the measures used a mature level has been reached in either written or oral stories. 204 pages. $2.55. Mic 56-1732

PHYSICAL GROWTH AND SUCCESS IN UNDERTAKING BEGINNING READING: A STUDY OF THE RELATIONSHIP BETWEEN CERTAIN ASPECTS OF PHYSICAL GROWTH AND SUCCESS IN UNDERTAKING READING IN THE FIRST GRADE

(Publication No. 16,593)

Sol Robert Karlin, Ph.D.
New York University, 1956

Statement of the Problem

The purpose of this investigation is to determine what measure or combination of measures of certain aspects of physical growth are related significantly to success in undertaking reading in the first grade of a public elementary school system.

Significance of the Problem

It is held generally that many failures in beginning reading may be prevented by determining whether or not a child is ready to undertake this difficult learning task. The factors which influence readiness have not been identified fully nor have their relative importance been determined. It is for these reasons that there is need for ascertaining which factors are related to reading readiness and reading achievement.

Previous Research

There have been many studies which attempted to discover what relationship, if any, existed between physical growth and intelligence as measured by standardized tests. The findings of these studies indicate that while one cannot predict mental status from physical status for any one individual, those who deviate greatly from the norm in mental status may be expected to deviate from the norm in physical status. Few investigations have sought the relationship between physical development and reading achievement and none has determined the extent of relationship between these measures of growth.

Procedure in Collecting the Data

The population from which the sample was drawn consisted of the first-grade pupils in four public elementary schools. To these children were applied six criteria of normality; those children who failed to achieve the minimum requirement in each instance were not included in the sample. Measurements of carpal or skeletal development, height and weight were taken when the investigation was begun and nearly concluded. The Metropolitan Reading-Readiness Test was administered to the children in the sample at the beginning and the Gates Primary Reading Test, Paragraph Reading, at the end of the study.

The Results

Intercorrelations for the dependent and independent variables with their standard errors of estimate were found. First and second order partial correlations with their respective standard errors of estimate were obtained and multiple coefficients of correlation and their standard errors of estimate were drawn. Regression equations and multiple-regression equations with their standard errors of estimate were secured. An examination of the results reveals little or no relationship between the measures of physical growth and the reading-readiness test scores. Correlations of .307 and .357 between skeletal growth in

October and May, respectively, and reading achievement test scores exist, but they are too small to permit predictions for any one individual. The addition of height and/or weight does not contribute anything to the size of these correlations.

Conclusions

The sample of the population used for this investigation consisted of one hundred eleven pupils in the first grade of four public elementary schools. Growth measures—skeletal growth, height and weight—of these children were correlated with reading-readiness and reading achievement test scores. An analysis of the data revealed that the above-mentioned aspects of growth did not appear to be related to reading-readiness test scores. While the relationship between skeletal growth and reading achievement test scores is significant, it is too small to overcome the factor of chance when predictions of the dependent variable are attempted. 143 pages. $1.79. Mic 56-1733

THE RELATION BETWEEN MEASURED VOCATIONAL INTERESTS AND JOB SATISFACTION

(Publication No. 16,558)

Clair Garfield Kloster, Ph.D.
University of Minnesota, 1956

Do men who enter occupations congruent with their vocational interests as measured by the Strong Vocational Interest Blank experience more job satisfaction than do men who enter occupations not congruent with their vocational interests? A group of 94 former University of Minnesota students were interviewed in an attempt to find at least a partial answer to this question.

Forty-seven of these men constituted the experimental group. They were judged by three experienced counselors at the University of Minnesota to be engaged in occupations not appropriate for their SVIB patterns on the basis of tests taken when they entered the University in 1939 and 1940. These are hereafter referred to as the poorly-placed group. The control group of 47 men who entered the University at the same time were judged by the same counselors, to be engaged in occupations very appropriate for their SVIB patterns. The control or well-placed group were paired, individual by individual, with members of the poorly-placed group on the basis of similarity of occupation.

During the summer months of 1952 and 1953 these 94 men were interviewed individually. During the interview each man gave a short occupational history, cooperated in a semi-standardized word-association procedure designed to elicit unguarded expressions of attitudes toward job, filled out the Hoppock Job Satisfaction Blank, the Brayfield Job Satisfaction Blank, and an instrument designed by this writer called the Occupational Questionnaire. Each interviewee also reported his net annual income. After the interview each subject completed a retest of the SVIB and returned it by mail.

The total group contained 16 men engaged in occupations classified as SVIB group I, 6 in SVIB group IV, 12 in SVIB group V, 32 in SVIB group VIII, 22 in SVIB group IX, and 6 in SVIB group X. In each SVIB group there were an equal number of men well-placed and men poorly-placed on the basis of SVIB patterns.

The mean age of the two groups was almost identical. The well-placed group showed, at time of college entrance, lower academic ability than the poorly-placed group. Twelve product moment correlations between measures of academic ability and measures of job satisfaction were calculated. None of the resulting correlations was statistically significant. It was therefore concluded that any differences in job satisfaction between the two groups could not be attributed to this observed difference in academic ability.

The job satisfaction data show considerably greater job satisfaction for individuals classed as well-placed in SVIB interest groups I, IV, VIII, IX, and X. For the 12 men in group V occupations, the six men who were originally classed as poorly-placed reported as much job satisfaction as did the six men originally classed as well-placed.

Analysis of the SVIB retest results showed a definite tendency for interests in the group V category to strengthen between age 19 and 32. This was true not only for men engaged in group V occupations but for men in other occupations as well.

For the entire group the job satisfaction data and net annual income data were subjected to analysis of variance treatment. The results showed highly significant differences in favor of the well-placed group in the amount of job satisfaction reported. The data on net annual income show that the well-placed men in groups I, IX, and X had significantly higher incomes than did the poorly-placed men in these interest groups. No significant difference in net annual income for groups IV, V, and VIII was observed. 327 pages. $4.09. Mic 56-1734

WORD PRONUNCIATION IN THE ORAL SIGHT-READING OF THIRD-GRADE CHILDREN

(Publication No. 16,564)

John Lewis Schummers, Ph.D.
University of Minnesota, 1956

This study attempts to determine the extent of certain pronunciation errors in the oral reading of third grade public school children, as well as to determine what relationships exist between the frequency of these errors and the factors of sex, intelligence, accuracy of oral reading, and difficulty of the reading material.

122 boys and 115 girls were selected randomly from the third grades of the St. Paul, Minnesota public schools. The average IQ of the sample is 110 based on a group test of intelligence administered in 1st grade. The boys and girls are of equal IQ.

The children read orally at sight from five stories of increasing reading difficulty from the Lyons and Carnahan Developmental Reading Series. The stories are graded in equal increments from grade 1.7 to grade 5.6 by means of the Spache and Lorge readability formulas. The stories average 124 words in length. Twelve pronunciation errors made by the children were recorded by the examiner on dittoed copies of the stories. The errors are: Primary Errors: sounds omitted, sounds added, reversals, vowel

alterations, consonant alterations, vowel-consonant combination alterations, substitutions; Secondary Errors: words omitted, words added, hesitations, word-sequence reversals, repetitions. Agreement among three examiners in recording errors is 94%; agreement in scoring errors is 86%.

The sample of children is divided into three groups of intelligence levels: low IQ (72-100), medium IQ (101-118), high IQ (119-152). The children are also grouped into three groups of accuracy of oral-reading word-pronunciation: low accuracy (up to 85%), medium accuracy (85-94%), high accuracy (95% or above).

All twelve pronunciation errors are reported in descriptive terms in relation to: sex, intelligence, and reading level of the stories. Chi-square and t-tests are reported for the relationships between each primary error and: the intelligence level of the children, the reading level of the stories, and the accuracy of word-pronunciation of the children.

Results:

1. There is a significant difference in the mean number of primary errors between the boys and the girls.
2. 58% of the total errors of the boys are secondary errors; 47% of the total errors of the girls are secondary errors.
3. The patterns of the percentage of errors for the boys and girls are essentially the same. The largest percentage of total errors for both boys and girls is hesitation errors—the boys make 48% and the girls make 30% hesitation errors. The next largest percentage of errors for both boys and girls is the vowel-consonant combination —12%. Word-sequence reversals are the least frequent error.
4. The girls read third-grade material with 90% accuracy in word-pronunciation; the boys read third-grade material with 80% accuracy.
5. Accuracy of word pronunciation tends to increase with increase in IQ level and to decrease with increase in the reading level of the stories.
6. The patterns of error proportions do not tend to change with increase in IQ. Reversals, vowel errors, and omission of sounds tend to be more prevelant in the stories of greater reading difficulty; otherwise, the patterns of error proportions do not tend to change with increase in the reading level of the stories.
7. Vowel-consonant combination errors tend to decrease with increase in accuracy of word pronunciation; otherwise, the patterns of error proportions do not tend to vary with change in accuracy of word pronunciation.

234 pages. $2.93. Mic 56-1735

EDUCATION, TEACHER TRAINING

AN EXPERIMENTAL EVALUATION OF CERTAIN MOTION PICTURE FILMS IN SELECTED EDUCATIONAL PSYCHOLOGY CLASSES IN KANSAS COLLEGES

(Publication No. 16,551)

Wesley Caspers, Ph.D.
University of Minnesota, 1956

Adviser: Robert J. Keller

THE PROBLEM

The purpose of the study was to evaluate experimentally the instructional use of several sound films available for students of educational psychology. More formally stated, it was the purpose of the study to measure the differential effect of different patterns in the use of sound motion pictures on professional teacher attitudes and on achievement in educational psychology courses in programs of teacher education in Kansas.

METHODS AND PROCEDURES

Sixteen films were chosen for evaluation. In order to provide independent comparisons the films were selected in four subject matter areas commonly included in educational psychology courses: Growth and Development, Individual Differences, Learning in Groups, and Motivation and Interest. The experimental design provided for the evaluation of the use or non-use of films in each of these four subject matter areas. Additionally, the effect of using only one or two of the four films for each area was assessed.

The effectiveness of the films was measured in terms of a specially constructed achievement examination based upon the content of the sixteen films. This test was developed during careful previewing and was validated through item analysis and correlation with final objective test scores. The effectiveness of the films was judged by comparing pre- and post treatment scores earned on each subtest by students who viewed or did not view the selected films in a predetermined randomized blocks design. In addition, the standardized Minnesota Teacher Attitude Inventory was administered both as a pretest and as a post test.

SAMPLING AND ANALYSIS

The 216 experimental subjects were drawn from students of educational psychology in six Kansas colleges. Twelve classes, each of eighteen randomly selected students, viewed a selected pattern of seven of the sixteen films. The pattern of the viewing was arranged in such a way that four groups, of three classes each, received a different treatment in number and pattern of the films they had seen. The number of films viewed in each of the four subject areas varied; four films were presented in one area, two in a second, one in a third, and none in the fourth. A comparison of the effect of the treatments, through analysis of variance and covariance of the pretreatment and post treatment test scores, provided the bases for evaluating the effectiveness of the films.

RESULTS

The chief findings were as follows:

1. All classes gained in mean achievement during the semester of experimentation in each of the four subject matter areas: Growth and Development, Individual Differences, Learning in Groups, and Motivation and Interest.
2. The classes became more alike in overall average achievement during the semester.
3. Achievement in a subject matter area was directly associated with greater use of films up to the maximum of four used in each subject area.
4. Achievement gains were related to the number of films used. The increased use of films, again up to the four used in each subject area, brought about increased gains.
5. Attitudes, as measured by the Minnesota Teacher Attitude Inventory, improved significantly during the semester for all classes.
6. No significant differences in attitudes were produced through the presentation of different patterns of films to the experimental groups.

These findings revealed that achievement, as measured for the selected subjects in Kansas colleges, was directly associated with greater use of films up to the maximum of four used in each subject area, thus indicating the general effectiveness of films in this undergraduate professional course. 239 pages. $2.99. Mic 56-1736

A RESOURCE RESEARCH IN ELECTRICITY: FOR AMERICAN INDUSTRIAL ARTS EDUCATION WITH IMPLICATIONS FOR TEACHER EDUCATION

(Publication No. 15,823)

William Luther Deck, Ph.D.
The Ohio State University, 1955

The dissertation includes an historic research on electricity in early times — or from the age of superstition to the age of science — which is followed by a systematic and exhaustive resource or content study of contemporary electrical knowledge and practice reported under seventeen headings enumerated below. By way of application, the subject matter thus recorded is then adapted by examples to the industrial arts curriculum from elementary to adult and service levels, and the dissertation concludes with a chapter of implications for teacher education.

FINDINGS OF THE RESOURCE STUDY

These are prefaced by two background chapters, one entirely historic, and the other a preliminary or contemporary view of the spread and increasing use of electricity in agriculture, industry, science, and the future. The major resource chapter includes a presentation of each of the following seventeen subject matter headings or categories: (1) characteristics, (2) magnetism, (3) electron theory, (4) voltage, (5) current, (6) cells, (7) conductors, (8) measurement, (9) circuits, (10) condensers, (11) induction, (12) transformers, (13) relays, (14) switches, (15) dynamos, (16) transmission, and (17) rectifiers. A fully annotated list of fifty major technical references concludes this chapter.

The nature and extent of industrial arts education is next examined, after which examples of proposed instructional units of electricity are presented for each level: elementary, secondary, technical, adult, and service. These are followed by a special chapter of suggestions and implications for teacher education.

CONCLUSIONS AND RECOMMENDATIONS

The technical development and commercial use of electricity and electronics has come with a rush — for all practical purposes — since the turn of the century. It is now a twenty billion dollar industry and affects the life of every person in the United States. Even so, the U. S. Office of Education reports that not more than 10 per cent of the 30,000 industrial arts teachers involved have received training in this subject, and fewer than 3 per cent offer it as a program of realistic proportions. The findings of this study have stimulated the following conclusions and recommendations.

1. Instructional units in electricity must be taught at all levels, elementary through adult or from magnetism through electronics, by the conclusion of the secondary school. Its integrational possibilities are enormous and must be exploited, including the mathematical, scientific, economic, and certainly the cultural implications.
2. A companion dissertation on electronics should be done so that the subject matter of that field can be made available to industrial arts and technical education people. A set of subdivisions similar to the seventeen listed in Chapter IV include the following: (1) waves, (2) detection, (3) theory, (4) measurements, (5) rectifiers, (6) circuits, (7) tubes, (8) receivers, (9) amplifiers, (10) resistors, (11) capacitors, (12) modulators, (13) inductors, (14) oscillators, (15) resonators, (16) antennas, and (17) transmitters.
3. Administrative officers at state and local level need to clarify their appreciation of electricity and the need for it in the schools at all levels by making explicit recommendations as well as by arranging for the necessary funds.
4. Teacher education programs need badly to clarify their purposes, to offer much better programs than at present, and to coördinate the interests of those concerned.
5. Organized experimentation and developmental work needs to be encouraged at all levels and in all parts of the country by the associations, by the awards programs, and even by the manufacturers and distributors concerned.
6. The literature necessary to this field has not been developed and needs to be stimulated, after which it will need to be revised periodically to keep pace with the rapid advancements of the industry, especially in electronics.
7. Refresher and in-service training courses will need to be offered as the above recommendations are carried out, not only in order to keep the industrial arts profession abreast of trends, but to fill the present void.
8. The industry itself must be stimulated to appreciate the significance of the programs described in Chapter VI and to coöperate actively in their development.

277 pages. $3.46. Mic 56-1737

PROFESSIONAL COMPETENCIES NEEDED BY BEGINNING TEACHERS OF VOCATIONAL AGRICULTURE

(Publication No. 16,752)

Jesse Anderson Morris, Ed.D.
Michigan State University, 1956

Purpose: The general purpose of this study was to analyze teaching competencies in order to ascertain implications for the improvement of the professional education of prospective teachers of vocational agriculture.

Method: A list of 154 competencies was secured from the literature on teacher education. A jury of professional educators reviewed the list which was sent in questionnaire form to 397 selected Negro teachers of vocational agriculture in 16 states. Returns were received from 60.9 per cent of the teachers. These teachers used a rating scale with degrees ranging from "0" to "5" to rate the degree of importance and the degree of development of each competency.

Findings and interpretations: The competencies were listed in the areas of "planning and organizing", "teaching", and "public relations". The importance ratings assigned to the competencies ranged from 2.98 to 4.76, while the development ratings ranged from 2.80 to 4.53. The importance ratings made by the less experienced teachers had a mean of 4.27 and a standard deviation of .32, while those made by the competent, experienced teachers had a mean of 4.21, with a standard deviation of .26. Significantly high agreement was found between the two groups of teachers on the importance and development ratings assigned to the competencies. Significant positive correlations were found between the importance and the development ratings made by each teacher. Both groups of teachers rated each competency higher in importance than in development.

The teachers rated 13 per cent of the competencies on a higher level of importance, 70 per cent on an intermediate level, and 16.9 per cent on a lower level. Competencies in the area of "public relations" were rated higher in importance and development than those competencies in the areas of "planning and organizing", and "teaching". Only 35 per cent of the competencies were indicated to need almost complete preservice development. It was also found that 65 per cent of the competencies will not need to be developed as high during preservice training as those requiring almost complete development.

The investigator concluded that: (1) these professional competencies have a direct relationship to effective teaching in vocational agriculture; (2) all of the competencies are very important and will need a high degree of preservice development; (3) the level of preservice development for each competency might best be obtained from the ratings made by the less experienced teachers; (4) competencies in the area of "public relations" will need a higher degree of preservice development than those in the other areas; and (5) certain of the competencies will need considerable in-service development.

The writer recommended that teacher educators use the list of professional competencies and their ratings to plan, evaluate, and improve those phases of the professional training program which they encompass. It was also suggested that prospective and beginning teachers of vocational agriculture should use these data for the self-evaluation of their professional growth and development.

154 pages. $1.93. Mic 56-1738

CREATIVE TEACHING IN ELEMENTARY SCHOOLS: ITS BASIS IN RESEARCH, WITH ILLUSTRATIONS OF PRACTICE IN SELECTED AREAS

(Publication No. 15,065)

James Ambrose Smith, Ed.D.
Syracuse University, 1955

The major purpose of this project is to utilize the findings of research and the experiences of teachers in creating a book which will help elementary classroom teachers to put into practice the science of education and the art of teaching.

An extensive study has been made of the available research in elementary education and related areas. This research has been used to document the text and pertinent research appears in abstract form at the end of each chapter so teachers may know the direct source of the material utilized in the book.

A survey was made of books, articles and periodicals of the past ten years for evidences of interpretation of this research by educators and teachers. Sample abstracts of this literature also appear as resource material for teachers.

The text is amply illustrated with pictures, charts and diagrams made from visits to numerous classrooms.

The material is presented by first interpretating the creative aspects of the modern elementary school. One stated objective of elementary education is that of refining communication. The structure of the book is based on this objective and the book is divided into three categories: (1) the communication of feelings through the creative arts; (2) the communication of ideas through the language arts and (3) communication through social living.

In the first part of the book, creativity is defined and the purposes for creative arts teaching are stressed with detailed discussions in the areas of art, music, rhythms and dancing, written and oral expression.

In the section on the language arts the areas discussed include: creative expression, listening, reading, handwriting, word usage, spelling, and literature.

In the section on social living the techniques and subject matter for creating better human relationships are presented.

The unique contribution of this instrument is its attempt to promote philosophy and interpret scientific study through illustration of creative methods throughout the text. Its style and language is directed to the regular classroom teacher, though it may also be of help to school boards, lay people, administrators, supervisors and college professors in curriculum building.

764 pages. $9.55. Mic 56-1739

A STUDY OF DOCTORAL TEACHER-EDUCATION AS IT RELATES TO THE SCHOOL EXPERIENCES OF MEN AND WOMEN GRADUATES WHO EARNED DOCTORATES IN THE SCHOOL OF EDUCATION OF NEW YORK UNIVERSITY DURING THE PERIOD 1935-1943 (VOLUMES I - V)

(Publication No. 12,244)

Marie C. Vilhauer, Ph.D.
New York University, 1954

The Problem

The problem is a study of graduate teacher-education as it relates to the school experiences of men and women who were granted the degree of Doctor of Education or Doctor of Philosophy by the School of Education of New York University during the first nine-year period (1935-1943) of the existence of the dual doctoral program in this institution.

Part I is an analysis of the graduate teacher-education and school experiences that were had by 234 cooperating doctors to show relationships existing between the two factors.

Part II is (1) an evaluation growing out of the experiences of the graduates of the New York University doctoral teacher-education program, and (2) suggestions for improving the program.

Purposes of the study were: (1) To discover relationships between various aspects of doctoral teacher-education and elements of school experience, (2) to discover attitudes of the graduates toward their doctoral teacher-education program and reasons underlying the attitudes expressed, (3) to make comparisons throughout the study between men and women groups and between doctors of philosophy and doctors of education, and (4) to obtain expressions of opinion, observation, and judgment on matters of concern to teachers and prospective teachers contemplating doctoral degrees.

It is hoped that the findings of this study, with their guidance and curricular implications, may serve definite needs of prospective doctoral candidates and of teacher-preparing institutions that grant doctoral degrees.

Sources of Data and Method of Procedure

Two kinds of data, facts and opinions, were secured from two sources: (1) Factual information concerning doctoral teacher-education each candidate had was taken from the permanent records in the Recorder's Office of the School of Education, and (2) data concerning each candidate's school experiences, his attitude toward doctoral teacher-education, and expressions of opinion and judgment were obtained directly from the graduates by means of the questionnaire technique.

Individual studies were made of the 234 cooperating graduates (128 Ph. D.'s—95 men and 33 women, and 106 Ed. D.'s—78 men and 28 women), and the findings in Part I were then presented according to some basis of grouping, depending upon the kind of relationship sought. In Part II, the cases were all identified by number to facilitate individual analysis, but the data were also tabulated according to the four doctoral groups—Ed. D., Ph. D., men, and women—so as to cause uniformities to stand out and to make possible comparisons between the groups.

Causes underlying responses were sought in two ways: (1) By asking the graduates to state their reasons and to comment upon their attitudes and opinions expressed, and (2) by compiling in tabular form supplementary data selected from the education and school experience histories of the graduates which were thought to contain or constitute "possible reasons" not expressly stated.

Tabular presentation has been employed extensively, 269 tables being used, 185 in Part I and 84 in Part II.

Findings, Conclusions, and Recommendations

Space limits of this brief review and the broad scope of the problem permit only a few of the numerous findings and generalizations growing out of this study to be presented here.

Some of the relationships discovered were:

1. The relationship between field and level of specialization and
   a. field and level of employment
   b. types of institutions in which the graduates were employed
   c. regions of employment
   d. use made of preparation in research
2. The relationship between preparation for research and use made of preparation for research
3. The relationship between the kind of graduate degrees earned and the type of institution in which employment was had.

Attitudes expressed toward doctoral teacher-education included these:

1. Satisfaction in having acquired the doctorate
2. Satisfaction in having acquired the doctorate in the School of Education of New York University
3. Satisfaction with the kind of doctorate (Ed. D. or Ph. D.) earned
4. Satisfaction, in general, with the program of studies pursued.

Typical suggestions and recommendations for improving the administration of the doctoral program included:

1. That as a means of selecting candidates, the personal interview, as well as the written preliminary examination, be employed; and that much weight be given to personality factors and to success in one's field;
2. That the "tools of research" requirement be modified so that only the tools that are likely to be functional will be required;
3. That the faculty supervisors of doctoral research be given lighter teaching loads and fewer candidates to supervise;
4. That a program of subject matter in the candidate's teaching field be required or includable in addition to the program in education, to prevent narrow specialization in education; and
5. That the Ed. D. program, in particular, take into account the importance to practicing school men of competence in public speaking and professional writing.

Typical expressions of opinion, observation, and judgment included the following:

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

1. For college and university teaching, a doctorate is of much value as a professional investment; it is of paramount importance for teaching in a large percentage of the institutions of higher education where a doctorate is required as a condition of employment or of promotion;
2. For administrative positions and department headships in the larger systems, a doctorate may well be a worth-while professional investment, though much would depend upon the individual and attending circumstances. However, doctoral degrees are not necessarily a guarantee of good teaching, and teaching competence may be secured by other means.
3. The most desirable age at which to begin graduate study was thought to be from 25 to 30, though much sentiment favored one's obtaining the doctorate at whatever age circumstances would permit, be it young or old;
4. Discrimination against Ed. D.'s was experienced or observed in only a few instances, but Ed. D.'s were generally not found employed by arts-science colleges; and
5. Discrimination against women in educational institutions was negligible, as reported by the graduates.

Conclusions

Findings of the study seem to warrant the following conclusions:

1. Preparation for teaching careers represented by the Ed. D. and the Ph. D. programs has proved highly functional in the school experiences of the graduates who earned doctoral degrees in the School of Education of New York University during the years 1935-1943.
2. The Ed. D. program, as well as the Ph. D., has functioned toward ends desired by the recipients in most respects. Satisfaction with the kind of doctorate earned was slightly greater among the Ph. D.'s than among the Ed. D.'s, but the latter were more often found employed in the field of their doctoral specialization.
3. Doctoral teacher-education has proved somewhat less effective for women groups than for men groups. Though a smaller percentage of the women than of the men considered the doctorate a worthwhile professional investment, practically all of the women would again seek a doctorate, their attitude being that

   > Though doctoral degrees may not always bring the highest positions or financial remuneration commensurate with the effort, expense, and sacrifices involved, they bring personal satisfaction, broadened interests, and enrichment of life.

4. Attitudes expressed by the graduates toward their alma mater lead to the conclusion that, while enjoying the advantages of being a large institution, with prestige, leadership, and recognition among schools of higher education, the institution has also maintained those values generally claimed by small schools—close teacher-student contacts, individual attention to students, small classes, a democratic philosophy, and high standards of scholarship.

Recommendations

1. It is recommended that the findings of this study be used as a basis for a critical examination of doctoral programs.
2. It is recommended that the study be projected from 1943 to the present to determine whether the criticisms of doctoral teacher-education made in 1943 seem warranted at this later date.
3. It is recommended that no effort or expense be spared to maintain those values that mean most to the graduates, foremost among which is a superior faculty of master teachers—inspiring, encouraging, understanding, and capable.
4. It is recommended that the two differentiated doctoral programs be retained, inasmuch as they serve differing needs and interests of practicing school men and women. Though the Ph. D. recipients have not devoted their time chiefly to research, and did not anticipate doing so when they undertook their doctoral program, they have shown a greater interest in research than have the Ed. D. graduates.

1978 pages. $24.73. Mic 56-1740

EDUCATION, THEORY AND PRACTICE

A FOLLOW-UP STUDY OF GIFTED ST. LOUIS PUBLIC SCHOOL PUPILS OF THE 1920s

(Publication No. 16,625)

Katherine Pfeifer Chambers, Ph.D.
Washington University, 1956

Chairman: Adolph Unruh

The study was an attempt to help answer two questions: (1) What factors seemed most influential in the adjustment of gifted persons? and (2) What could the schools do to provide more favorable programs for them?

St. Louis elementary school pupils born in the decade 1910-1920 with recorded I.Q.'s of 135 or higher were studied. From the 850 eligible, three groups were selected: (1) a random sample of 328 persons, (2) the 139 persons whose school records indicated exceptionally poor socio-economic backgrounds, and (3) the 122 persons whose I.Q.'s were 147 or higher. The total number of individuals, because of overlap, was only 482 instead of the sum of the three groups. Returns, by interview or questionnaire, were tabulated for 249 persons. Losses included 36 discarded because of doubt as to the validity of the I.Q. record, the remainder being either deceased, not located, or failing to return the questionnaire.

The data were derived from school records, interviews, and questionnaires. They consisted of (1) objective data on family background, place of residence, siblings, parental attitudes and interests, and cultural features of the home; school accomplishments including quality of work, amount of acceleration, educational level attained, extra-curricular activity, and honors received; and adult adjustment

including occupation, marriage and family status, health, leisure activities, civic participation, and honors and publications; and (2) opinions concerning personal educational experiences and desirable provisions for gifted children. On the basis of these data, the three groups were compared among themselves, with Terman's subjects, with the former Cleveland Major Work students surveyed by Barbe, and with the nine thousand college graduates of the Time survey. Twenty-eight individual cases were analyzed in some detail.

Comparatively poorer adjustment of the low socio-economic group was shown by significant differences between it and the others in educational attainments, percentage in professional or managerial occupations, percentage of divorce among female subjects, and hours per month devoted to civic activities. These differences, plus a strong correlation between parental education and educational attainments, indicated the tremendous effect of family background. Persons who transcended meager home environments were aided by outside stimulation from some person or community agency, most often school or library.

Subjects with I.Q.'s above 147, compared with the random sample, showed consistently higher achievement educationally and occupationally, although the differences were not quite significant. Percentages dissatisfied with their own school experiences, and of those participating as adults in purely cultural civic activities were significantly greater.

In both Terman's and Barbe's groups the percentages entering college and elected to Phi Beta Kappa were significantly higher than in the St. Louis random sample, and the percentage dissatisfied and quitting school because of lack of interest was significantly greater in the St. Louis study than among Major Work students. These comparisons suggest the value of early identification, and warrant further experimentation with provisions offered in the Major Work program—ability grouping; conversational foreign language in elementary school; and the encouragement of good study habits, creativity, and responsibility through group activity.

Comparison with the Time survey indicated strongly that college graduation is a better predictor of occupational success than is a high I.Q., but that high intelligence plus college education affords the best guarantee. The significantly greater amount of time spent in civic activities by college as compared to non-college persons also showed the value to society of higher education for the intellectually capable.

The foregoing broad conclusions notwithstanding, much still needs to be learned about specific effects of educational provisions on different individuals under diverse conditions. Hence, enrichment programs should be in essence action research projects, providing for continuing evaluation of results. 255 pages. $3.19. Mic 56-1741

A COMPARISON OF THE EFFECTIVENESS OF TWO GROUP DISCUSSION METHODS

(Publication No. 15,031)

Francis James Deignan, Ed.D.
Boston University School of Education, 1955

The general purpose of this teaching methods study was to determine the relative effectiveness of two different discussion methods on students' learning of psychology and in bringing about changes in their emotional adjustment. Several hypotheses were tested; (1) freshman design students will learn more psychology if the course is conducted according to a lecture plus student-centered discussion method than they will in lecture plus instructor-centered discussion classes, (2) the more frequently students participate in the class discussions, the more psychology will they learn, (3) student-centered group discussions will bring about greater and more desirable changes in emotional adjustment than will instructor-centered group discussions, and (4) students who are given the responsibility for conducting their own discussion sessions will more highly evaluate the course and the instruction than will students in discussion classes controlled by the instructor.

The subjects were one hundred thirty fine arts college freshmen divided into ten sections. They were systematically assigned to experimental or control sections on the basis of the alphabetical order of their surnames. Comparisons of the previously earned grade point averages, scores on a 150-item objective examination in psychology, and pre-test scores on The Gordon Personal Profile and the Rotter Incomplete Sentences Blank indicated that no significant differences between experimental and control subjects on these dependent variables existed at the beginning of the experiment.

One male and one female instructor acted as discussion leaders. The woman led two student-centered and three instructor-centered discussion classes each week throughout the experimental semester, and the male instructor conducted three student-centered and two instructor-centered sections. In addition, the male instructor, who was also the investigator, gave all of the once-weekly lectures which were attended together by both experimental and control subjects. The experimental variable in this study was the method used by the instructors in conducting the class discussions. In the five sections designated as student-centered the students were given the responsibility for the initiation or the change of discussion topics. The instructor encouraged the students to assume the responsibility of maintaining the class discussions by restating the intellectual content of statements directed toward him or verbally reflecting the emotionally-toned student contributions. On the other hand, the control group discussion leader conducted his classes according to the methods more usually used in college teaching. He chose the topics for discussion, asked questions of the class, corrected inaccurate or incomplete statements made by the students, and maintained complete control of the discussions. Qualified observers made unannounced and irregular visits to both control and experimental class discussions and rated the verbal behavior of the instructors on a standardized scale which categorized teacher statements along a student-centered to instructor-centered continuum. Participation counts were maintained of both student and

teacher contributions throughout the duration of the study. Climate indices computed from the observers' ratings, analyses of thirty transcribed tape recordings of class discussions, and teacher and student class participation counts confirmed the use of differing discussion methods in the experimental and control sections.

Post-test data on which analyses of variance were computed required the rejection of the first three hypotheses, except that frequency of participation in the class discussions, the second hypothesis tested, was found to be positively related to subject matter gains for the control group and negatively related to psychology examination scores for the experimental subjects. The experimental group evaluated their discussion method more highly than did their controls. Follow-up testing one semester after the conclusion of the experiment, using the same instruments, disclosed no significant differences between means of experimental and control subjects.

375 pages. $4.69. Mic 56-1742

A SUGGESTED METHOD FOR THE DEVELOPMENT OF A TOOL TO AID IN THE EVALUATION OF PERFORMANCE IN NURSING

(Publication No. 16,535)

Katherine Janet Hoffman, Ph.D.
University of Washington, 1956

Supervisor: August Dvorak

The study was concerned with the development of a procedure for evaluating performance in nursing. The importance of performance evaluation has been recognized by writers in nursing education. Various established techniques of measurement have had their limitations. Typically, they have been time consuming. The results have been often unsatisfying to both instructor and student. It appeared that if an instrument could be developed which included only those elements of behavior which were critical or crucial many of the criticisms of current methods could be resolved.

In nursing education, objective data as to which were the critical behaviors were lacking.

Nursing care involves a large number of component behaviors. For purposes of the study, five typical, representative nursing procedures were selected. In no sense was the study inclusive nor representative of total nursing care.

Two major hypotheses were posed: (1) there are certain steps or aspects of a nursing procedure which are highly related to successful performance, and (2) there are errors in performance which occur in conjunction with crucial errors. These errors may be easier to observe in the ongoing clinical situation than are the crucial ones.

The study demonstrated a possible method by which crucial steps or behaviors in performance of nursing care could be identified. The five nursing procedures were analyzed in terms of observable actions. A check list was developed for each procedure. Selected criteria were chosen by which to judge the degree of success in performance. Specific descriptions characteristic of success or failure in the light of the criteria were written. The data forms were reviewed by a committee of nursing arts instructors.

The study was carried out in a university school of nursing. Students were divided into three levels in terms of length of time in clinical nursing. Students were observed over a three-month period as they did the five procedures as a part of actual nursing care in the wards of the hospitals. Nine experienced nursing instructors used the check lists and the criteria forms in the systematic observation of student performance.

Observations were made of 115 performances of Administration of Oral Medications, 115 performances of Intramuscular Injections, 110 performances of Making an Empty Bed, 15 performances of Cleansing Enema, and 18 performances of Female Catheterizations.

Data were analyzed in terms of error patterns in both successful and failing performance by level of student for each procedure. Those steps in performance which differentiated between success and failure were identified. The discriminating steps were then examined for their relationships to the criteria by which performance had been rated. It appeared that there were certain steps which, within the limitations of the study, did differentiate between success and failure. Furthermore, some of these steps were easier to observe in the ongoing clinical situation than were others.

Examples of errors in steps in the procedures which were identified as crucial in terms of successful or failing performance were:

Administration of Oral Medications
- Failure to read the label on the medicine bottle three times.
- Failure to identify the patient in the established manner.
- Failure to stack the medicine cards in a pile before beginning to pour the individual doses (for older students).

Intramuscular Injections
- Errors in aseptic technique.
- Errors in computation of dosage.
- Failure to pull back on the plunger of the syringe before the medication was injected (for younger students).
- Failure to identify the patient in the established manner (for older students).
- Failure to check the label on the medication ampoule three times (for older students).

Observers appeared to have been able to rate performance in terms of the criteria. Typically, performances which had been judged successful contained errors which, if the criteria had been different, might have resulted in a different rating.

Findings from the study supported the hypotheses which had been set up. The importance of careful analysis of behavior in terms of observable action, of selection of criteria for judging performance which had a rational relationship to the action, and of specific descriptions which illustrated each criterion as an aid to the rating had all been emphasized. The method appeared to be a promising one to use in the development of an improved instrument in performance evaluation in nursing.

211 pages. $2.64. Mic 56-1743

A STUDY OF THE CHARACTERISTICS AND RANKING OF GRAMMATICAL USAGE IN THE SPEECH OF TWELFTH GRADE PUPILS AS RELATED TO SEX, INTELLIGENCE, AND SOCIO-ECONOMIC STATUS (WITH SUPPLEMENT)

(Publication No. 14,527)

Raymond Alfred Kehl, Ph.D.
University of Minnesota, 1955

The first purpose of this study was to document and to count the Non-Standard English usages found in the mechanical recordings of 1,000 running words of informal speech of each of 120 pupils who constituted a 5 per cent random sample of the 2,400 seniors enrolled in the public high schools of St. Paul, Minnesota.

The second purpose was to derive for each pupil a composite score on Non-Standard English usage in order to rank pupils according to ability levels in grammatical usage; to describe, for each sex, ability levels in grammatical usage.

The third purpose was to test hypotheses pertaining to the relationships between Non-Standard English usage and factors such as intelligence and socio-economic status; to attempt prediction of oral English usage scores; and to determine whether or not there is a significant difference in intelligence, for example, between deviators and non-deviators from Standard English in use of certain types of grammatical usage.

Exactly 178 different types of grammatical usage were documented as Non-Standard on the basis of recorded fact in the great dictionaries of the English language.

Syntactical (structural) deviations from Standard English accounted for over 60 per cent of the 1,008 deviations charged to the 120 pupils in this study despite the fact that the number of different types of morphological (inflectional) deviations rose to 100 and the number of syntactical deviations to only 50.

Classification of deviations under parts of speech revealed that 40 per cent pertained to misuse of adjectives, 30 per cent to misuse of verbs, and 20 per cent to misuse of pronouns. No sex difference appeared in the foregoing percentages. Such striking sex differences, however, did appear in the sheer number of deviations and the number of different types of deviations charged to boys, as compared to girls, that girls seemed overwhelmingly superior to boys in socially acceptable grammatical usage. Boys, however, in employment of Non-Standard English usages, showed both a greater vigor in power of expression and a greater variety in choice of expressions.

The dominating types of Non-Standard English usage consisted of pretty as an intensifier, the double subject, good for well, the double negative, have (elided), real as an intensifier, don't for doesn't, ain't, and seen for saw. The size of the Average Usage Quotient for users of scores of items indicated deep ingrainment of certain usages in the speech of those who employed the particular usages once or more.

Significant correlations (contradicted by results of analysis of variance) were found between Speech Usage Scores and scores on the ACE for both boys and girls. Significant correlations were found for girls but not for boys between Speech Usage and each of the following: High School Rank, Grammatical Usage, Effectiveness of Expression, and Mechanics of Expression. A significant correlation was found for boys but not for girls between Speech Usage and fathers' occupational level.

Analysis of variance also revealed (1) a significant difference in average socio-economic status for boys but not for girls grouped according to ability levels in Speech Usage; (2) a significant difference in Average Speech Usage Scores for boys but not for girls grouped according to fathers' occupational level; (3) a significant difference in average grammatical usage scores (Cooperative English Test) for girls but not for boys grouped according to ability levels in Speech Usage; (4) no significant difference in Average Speech Usage Scores for either boys or girls grouped according to fathers' education level; (5) a significant difference in Average Speech Usage Scores for boys but not for girls grouped according to mothers' education level.

Prediction of individual Speech Usage Scores proved to be impossible. 1029 pages. $12.86. Mic 56-1744

DIFFERENTIATED CURRICULUM DESIGNS ESPECIALLY WITH REFERENCE TO CURRICULUM PRACTICES IN THE HIGH SCHOOLS OF SOUTH CAROLINA (PARTS I AND II)

(Publication No. 16,622)

Melvin Eugene Timmerman, Ph.D.
University of South Carolina, 1956

Purpose of This Study

The purpose of this study is two fold, (1) to investigate and analyze the various curriculum designs which may be found among educational theories and practices developed within the past two or three decades, and (2) to apply the features of each curriculum classification analyzed in the first part of the study to the practices of South Carolina high schools which are members of the Southern Association of Colleges and Secondary Schools.

An evaluation of the curriculum designs as to their relative merits to achieve the objectives and outcomes of educational practices is not contemplated as a significant part of this study. It is assumed, however, that the designs of curriculum organization should be and are formulated and practiced to reflect the basic objectives and purposes of the school, and, in turn, are to be prescribed by the dominant customs and ideals of the society by which the schools are supported and in which they exist. Hence, this study (1) reviews the bases in which the aims and objectives of the school find their roots, (2) points out the curriculum designs which are posed to satisfy the specific purposes and objectives, and (3) designates means which these designs utilize in their attempt to fulfill their accepted purposes.

Nature of the Data

To achieve these purposes it is necessary to:

1. Determine from professional education literature and economic and social histories pertaining thereto, the dominant influences to which the secondary school curriculum as it has developed, has been responsive.

2. Investigate recent theories and practices of curriculum designs with emphasis upon elements common to various designs, and characteristics unique of and essential to each design.

3. Obtain, by use of a questionnaire, in the form of a check list, detailed information relative to curriculum practices in South Carolina accredited high schools.

Part One

In the United States, secondary school curriculums have developed in response to many and varied influences. Dominant among these influences are:

1. Religion and the classics.
2. Demands of a changing economy.
3. Ideal of equal educational opportunity and the popularization of secondary education.
4. The scientific study of education and a changing educational philosophy.
5. Adjusting education to an increasingly complex society.
6. The professional educator.

These and other influences upon the curriculum are so interrelated it is virtually impossible to establish a direct causal relationship between a particular present-day curriculum practice, and a particular social, economic, or religious factor or force in American life. Nevertheless, secondary school curriculum planning being largely a matter of making choices, many pressures are brought to bear, all of which have, in varying degree to be sure, affected the decisions made from time to time with respect to secondary educational programs and practices.

Numerous curriculum designs are found among educational theories and practices developed within the past two or three decades. These are classified into categories based upon their distinguishing features. The classification of the curriculum designs is made by combining these designs having the greatest number of common characteristics and dominant characteristics not common to the other designs as found in the analysis of the various curriculum patterns.

Part Two

Part Two of the study is based upon conditions found in South Carolina accredited high schools. There are sixty-four of these schools. Information with respect to the following aspects of the curriculums of fifty-four of these schools furnish the basis for an application of the curriculum designs established in Part One:

1. Curriculum design of each school.
2. Formal study of curriculum reorganization.
3. Purpose(s) of curriculum reorganization study.
4. Method(s) of teaching.
5. Source(s) and selection of learning experiences which make up the curriculum.

It is noteworthy that within the existing framework of the subject design of curriculum organization, many curriculum innovations which are largely characteristic of the more recent curriculum designs are evident in South Carolina high schools. Among these innovations are:

1. Thirteen schools (24%) have curriculums organized on the basis of broad fields.
2. Two schools (4%) have curriculum organized on the basis of a core of common learnings.
3. Five schools (9%) have curriculums organized on the basis of pupil initiated learning experiences and activities.
4. Twenty-two schools (40%) place major emphasis in teaching method upon problem solving.
5. Fourteen schools (26%) have learning experiences determined cooperatively by pupils and teachers.

These data demonstrate rather clearly that despite the subject-centered nature of requirements placed upon South Carolina high schools by various accrediting agencies, the more recent curriculum designs are exerting influence upon the curriculums of South Carolina high schools. This result is to be expected if judged on the basis of the substantial number of the schools (57%) engaged in formal study of curriculum reorganization, and on the basis of the reasons for initiating study of their curriculums. The inference may, therefore, be drawn that the curriculum innovations in South Carolina high schools are the results of local interest and effort involving reorganizing the curriculum. 173 pages. $2.16. Mic 56-1745

ENGINEERING

ENGINEERING, AERONAUTICAL

THREE-DIMENSIONAL EFFECTS IN SUPERSONIC COMPRESSOR APPLICATION OF ANALYTICAL METHOD TO THE DESIGN OF A STATOR PASSAGE. DEVELOPMENT OF ANALYTICAL-GRAPHICAL METHOD TO OBTAIN VARIATION OF THE BASIC DESIGN.

(Publication No. 12,512)

Aldo V. La Rocca, Ph.D.
Polytechnic Institute of Brooklyn, 1955

The application of a method derived from the linearized characteristic approach is illustrated in its application to the design of a stator passage for a supersonic compressor of the impulse type. The method is based on a property of the motion equations which follows the assumption for one of the three velocity components to be small. As a matter of fact, by writing these equations in a cylindrical rotating system it is possible to separate them in two parts. One is function of only two of the coordinate parameters and has been shown to represent a basic two dimensional hyperbolic flow; the other is a three dimensional linearized disturbance. The two flows are proven to have identical characteristic lines. Therefore it is possible to move on the characteristic two-dimensional nets of the basic flow to determine the three dimensional superimposed disturbances. The application of this method thus involves the drawing of the two dimensional nets in a discrete number

of planes in the cylindrical surfaces coaxial with the machine. Writing the motion equations along the characteristic line in a finite difference form and applying them in a step by step fashion an iteration process can be developed to determine the three dimensional superimposed disturbance flow.

According to this method a first stator giving a 36° turning and no pressure rise has been designed, and tested in a supersonic blow-down tunnel. Comparison between calculation and experiment data is given. The pressure recovery obtained has been of the order of 97%. A method has been then devised to permit a quick variation of the basic design avoiding the relevant amount of computational work involved in the preceding approach. This new method of analytical and graphical nature is based upon the theory of sources and sinks of finite rectangular form following the linearized supersonic flow theory. According to this latter method two more passages obtained by modification of the basic design have been built and tested. The pressure recovery of these, which involved beside the 36° turning also the maximum pressure ratio allowed by the starting requirements of the supersonic flow, has been of the order of 96%. The result of this investigation indicates that the method developed gives a good description of the flow field and good approximation with the experimental results. The value of the pressure recovery is high and therefore, high efficiency can be expected by a rotor and stator of impulse type having similar geometrical shape. Such a device could be efficiently used as a supersonic ducted propeller for transonic and supersonic flight.

112 pages. $1.40. Mic 56-1746

SUPERSONIC FLOW AROUND POINTED THREE-DIMENSIONAL BODIES

(Publication No. 15,335)

Marian Visich, Jr., Ph.D.
Polytechnic Institute of Brooklyn, 1956

An accurate method for calculating the flow field around three-dimensional bodies of arbitrary cross sections is necessary to determine the lift and wave drag characteristics of a supersonic airplane or missile as a function of the Mach number and of the angle of attack.

A comprehensive study of this problem has been made by linearized slender body theory. The linear theory yields results which are satisfactory for engineering purposes if the body to be analyzed is slender, is at a small angle of attack, and is in a free stream Mach number in the range between 1.2 and 2.5. If the above conditions are not satisfied, the shock waves which are created invalidate the assumption of small disturbances and yield results which are unsatisfactory.

The method presented in this dissertation permits the calculation of the flow field around pointed three-dimensional bodies of arbitrary cross section which may be considered to be perturbed about a circular cone. The analysis is based on the superposition of linear conical flow solutions on a non-linear axially-symmetric conical flow. The linear conical flow solutions are analyzed in the hodograph plane by the Busemann method.

The present method is first discussed in detail and then applied to the calculation of the flow field around conical bodies without axial symmetry, bodies of revolution and a general three-dimensional body. It is shown that for a given volume and length, a lower shock drag can be realized by using bodies having a cross section other than circular. A comparison is made of the pressure distribution around the bodies of revolution as calculated by the present method and by the linearized methods. It is shown that for a parabolic arc body of revolution with a thickness ratio of 0.35052 the pressure coefficient at the nose is in error by approximately 77 percent while the present method yields results which are in good agreement with the exact results.

61 pages. $1.00. Mic 56-1747

ENGINEERING, CHEMICAL

HEATS OF COMBUSTION OF SOME NITROALCOHOLS

(Publication No. 15,399)

Robert Marion Currie, Ph.D.
Purdue University, 1950

Major Professor: Dr. D. E. Holcomb

Using the adiabatic method of bomb calorimetry the heats of combustion of the following compounds were determined: 3-nitro-2-butanol, 2-nitro-2-methyl-1-propanol, 2-nitro-2-methyl-1,3-propanediol, 2-nitro-2-ethyl-1,3-propanediol, 2-nitro-2-propyl-1,3-propanediol, 2-nitro-2-isopropyl-1,3-propanediol, 2-nitro-2-methyl-1-phenyl-1-propanol, 2-nitro-2-methyl-3-phenyl-1-propanol, tris(hydroxymethyl)nitromethane, hydrazine hydrate, and trinitromethane. Statistical properties of the experimental results on the heats of combustion are given in Table I.[1]

The experimental values have been corrected to the standard conditions proposed by Washburn (33), and assuming the applicability of the perfect gas laws, the heats of combustion at constant pressure have been calculated. From the latter values heats of formation for the compounds have been calculated. A summary of the results is given in Table II.[1]

The heats of combustion of the solid nitroalcohols have been shown to be a linear function of the oxygen balance of the molecules, and an equation has been derived which fits the data with a standard error of estimate of 41.4 cal./g.

95 pages. $1.19. Mic 56-1748

1. Please see thesis for Tables I and II.

KINETICS OF THE PYROLYSIS OF OIL SHALE IN A FLUIDIZED SOLIDS SYSTEM

(Publication No. 13,763)

Leo DiRicco, Ph.D.
University of Colorado, 1955

Supervisor: Associate Professor Paul L. Barrick

This work was undertaken to correlate and reevaluate existing kinetic data and to study the effect of reduced pressure on the rate of the oil shale pyrolysis.

The apparatus used in the investigation was an electrically heated fluidized solids retort mounted above a cooling section which operated on the fluidized solids principle. Spent shale in the retort was used as a heat reservoir into which was dropped the raw shale. At the conclusion of a heating period, the charge was dropped into the cooling section where pyrolysis stopped almost instantaneously. This equipment served to give extremely large heating and cooling rates for the raw shale, enabling precise measurements of heating times to be made.

The oil evolved was recovered by adsorption on silica gel cooled with ice water. The retorted charge was extracted with dried, distilled benzene in order to determine the amount of kerogen converted to benzene soluble organic matter (bitumen). An overall material balance was then made in order to determine the amount of gas plus loss.

The experimental values of the rate constant (k) for the pyrolysis of kerogen in oil shale, determined over the temperature range of 465 degrees Centigrade to 250 degrees Centigrade (869 to 482 degrees Fahrenheit) and pressures of 625 to 50 millimeters of mercury, were correlated by an equation of the Arrhenius type as:

$$\log_{10} k = \frac{-17{,}800}{\text{Temperature deg. Rankine}} + 15.4$$

The effect of ambient pressure on the rate of kerogen pyrolysis was found insignificant.

The available data with which these results may be compared showed disagreement with one another over the temperature ranges considered, one of the works indicating a pressure effect on the rate of pyrolysis. The present work indicates larger values of the rate constant than reported in the literature at the lower temperatures while agreement with more recent work done at higher temperatures in a fluidized solids system is good.

The raw shale samples were Colorado oil shale which had a kerogen content of 12.9 percent and which yielded 24.2 gallons of oil per ton when analyzed by a modified Fischer assay. It was found, when grinding the oil shale for fluidized solids retorting using a laboratory type tube mill, that the optimum grinding rate using rods amounted to 73 pounds per hour compared to only 26 pounds per hour using balls. In addition, over ninety percent of the material ground using rods and approximately 56 percent of the material ground using balls was in a size range suitable for fluidized retorting. 75 pages. $1.00. Mic 56-1749

HEAT TRANSFER BETWEEN AIR AND SOLID PARTICLES IN SIXTEEN INCH DIAMETER FLUIDIZED BEDS

(Publication No. 16,162)

Jacob Christian Fritz, Jr., Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Charles C. Watson

The object of this investigation was to study the behavior of a fluidized bed at a scale larger than is commonly used in fundamental work. Heat transfer between fluidizing gas and solid particles was chosen as the experimental study because it required the simplest equipment and the least complicated means of analysing the results. In particular, the effect of three variables—bed height, superficial gas velocity and inlet gas temperature—on the overall heat transfer coefficient was studied. The various aspects of the problem to be investigated were: (1) to determine the mechanism of heat transfer between gas and solid in a fluidized bed, (2) to investigate the type of flow that prevails in a fluidized bed at various gas velocities and bed heights; and (3) to determine whether any of the models for fluidized bed behavior that have been proposed —particularly the parallel reactor—can be used to explain the results obtained in this study.

The experimental method consisted of the non-steady state heating of a bed of fluidized particles with air at an essentially constant inlet temperature. By assuming simplified conditions of mixing, an equation could be derived by which an overall heat transfer coefficient could be calculated.

A fluidized bed 16 inches in diameter was studied at bed heights of 4.5, 11.6, 24.6, 31.5 and 47.5 inches, respectively. The range of air velocities was from 0.139 to 1.310 ft/sec, and inlet air temperature ranged from 104 to 186°F.

Air was used as the fluidizing medium. The solid used was a spent commercial silica-alumina cracking catalyst, with average particle diameter equal to 60 microns.

The best correlation of results was obtained when complete mixing in the solid phase and piston flow in the gaseous phase were assumed. Inlet air temperature apparently had no effect on the heat transfer coefficient. The results could be correlated by the following equation:

$$U = \frac{v}{116 + 52.4(L/D)} + \frac{1.0 - 0.6(L/D)}{274 + 447(L/D) + 146(L/D)^2}$$

where U = overall heat transfer coefficient, Btu/(hr) (ft^2) (°F)

v = superficial gas velocity, ft/sec

L/D = bed-height-to-diameter ratio, where L is the settled bed height

Calculations of the approach of solid temperature to outlet gas temperature indicated that the type of flow that obtains in fluidized beds is essentially variable in nature, the range of variation increasing with increasing bed height. In a bed operating at constant gas velocity and in the upper range of bed heights used in this study, the type of flow was found to vary anywhere from almost complete channelling to complete fluidization from run to run, or from time to time, in any given run.

Equations were derived based on a parallel reactor model which predicted the empirical relationship between overall heat transfer coefficient and bed-height-to-diameter ratio. This derivation was based on two assumptions: (1) the fraction of gas in the dense phase is directly proportional to L/D, and (2) the fraction of solid in the dense phase is directly proportional to L/D. A comparison between the derived equation and the empirical equation indicated that the fraction of gas in the dense phase was at a maximum with respect to the fraction of solid in that phase at a superficial gas velocity of approximately 0.4 ft/sec over the whole range of L/D covered.

Measurements were made of the "surface tension" of a fluidized bed. Particle sizes investigated were 150/200, 250/270 mesh and a mixture with the same size distribution as that used in the heat transfer study. No correlation was found between surface tension and particle size, but surface tension was found to increase as bed height increased.

199 pages. $2.49. Mic 56-1750

A STUDY OF ANION EXCHANGE USING A MONOVALENT ION

(Publication No. 16,628)

Don Richard Kuehn, Sc.D.
Washington University, 1955

Chairman: L. E. Stout

A study was made of the exchange of chloride ions from aqueous hydrochloric acid solutions with the hydroxyl form of Amberlite IRA-400, a strongly basic resin. The effect of mass of resin bed, diameter of resin bed, linear velocity of exhaustant and concentration of exhaustant on the capacity of the resin bed was investigated. Using statistical methods the following variables were found to exert a significant effect on the capacity of the resin: mass of resin, concentration of exhaustant, concentration squared, concentration cubed, mass by concentration interaction, mass by concentration squared interaction, and diameter of bed by concentration interaction. An equation was developed which related the capacity of the resin bed, expressed as volume at breakthrough, to the significant independent variables. This correlation predicted 98.58 per cent of the variation in the dependent variable.

75 pages. $1.00. Mic 56-1751

SIMULTANEOUS HEAT AND MASS TRANSFER IN NATURAL CONVECTION

(Publication No. 16,571)

Wilson Graham Mathers, Ph.D.
University of Minnesota, 1955

Adviser: Arthur J. Madden, Jr.

SUMMARY

New Theoretical equations are derived for the rates of either heat or mass transfer from a vertical plate where both processes are taking place simultaneously under natural convection conditions. These equations are:

$$Nu = 0.670 \left[(Gr + (Pr/Sc)^{\frac{1}{2}} Gr') Pr\right]^{\frac{1}{4}}$$

$$\text{and } Nu' = 0.670 \left[(Gr' + (Sc/Pr)^{\frac{1}{2}} Gr) Sc\right]^{\frac{1}{4}}$$

Using the form of these equations it was found possible to plot on a single curve experimental data taken on spheres for simple heat transfer, for isothermal mass transfer, and also for combined heat and mass transfer.

96 pages. $1.20. Mic 56-1752

ULTRASONIC INSONATION EFFECT ON LIQUID-LIQUID EXTRACTION

(Publication No. 16,370)

Lawrence Patterson Murray, Jr., Ph.D.
Virginia Polytechnic Institute, 1956

Current acceptance of ultrasonic energy as a specialized type of industrial power has accentuated the need for fundamental investigation of phenomena associated with this form of energy. Application of ultrasonic energy to continuous liquid-liquid extraction has not been previously reported; however, selective micro-and macroagitation at interfacial boundaries has been observed by several investigators. This investigation employed ultrasonic insonation to accomplish intimate solvent-to-feed contact. The purpose of this investigation was to study the effect of ultrasonic energy on the rate of mass transfer in a continuous flow, three-component, two-phase liquid-liquid extraction system.

Acetic acid was extracted from a feed containing 16.20 $\pm$ 0.05 weight per cent acetic acid in benzene (saturated with water) with distilled water in a co-current, continuous-flow extractor which incorporated 400-kilocycle ultrasonic energy. The extraction was performed using a reactor designed for maximum utilization of the focused ultrasonic field. High-frequency electrical power was transferred into high-frequency vibrational mechanical power by a barium titanate, bowl-shaped transducer.

In a series of tests conducted without insonation, the stage efficiency of the extraction apparatus using the system benzene-acetic acid-water was 53.5 $\pm$ 0.5 per cent or, expressed in terms of extraction rate, 0.0366 pound mol per hour.

In a series of tests, using the same flow rates (10.0 $\pm$ 0.5 grams per minute for both feed and solvent) and system as employed in the control tests without insonation, the stage efficiency increased to a maximum of 84.5 $\pm$ 0.5 per cent with an insonation intensity of 3.20 watts per square centimeter. Expressed in terms of extraction rate, an increase from 0.0366 to 0.0578 pound mol per hour was obtained in tests using the maximum intensity of 3.20 watts per square centimeter.

When a relation between stage efficiency and intensity-time product for this ultrasonic liquid-liquid extraction was plotted on semi-log graph paper, a familiar "growth" type curve resulted, indicating that the greatest increase in stage efficiency from 53.5 to 83.0 per cent occurred between 5.0 and 50.0 watt-seconds per square centimeter. No increase in stage efficiency was obtained at lower

values of intensity-time product than five watt-seconds per square centimeter, and an increase of only 1.5 per cent stage efficiency resulted when the product increased from 50.0 to 100.0 watt-seconds per square centimeter.

Three separate and distinct mechanisms were postulated as being responsible for increased rate of mass transfer when ultrasonic energy is incorporated into an extractor: (1) reduced bubble size causes increased interfacial area and consequently increases the extraction rate, (2) selective microagitation at the interface between the dispersed and continuous phase reduced resistance at this boundary and thereby facilitated mass transfer, and (3) bulk agitation that accompanied the addition of ultrasonic energy to the system provided sufficient circulation of the two phases to insure a maximum concentration gradient across the phase boundary and maintain a maximum driving force for the extraction.

297 pages. $3.71. Mic 56-1753

THE SYNTHESIS OF PINIC ACID

(Publication No. 12,516)

Paul O. Pfeuffer, D.Ch.E.
Polytechnic Institute of Brooklyn, 1955

Attention has recently been centered on the potentialities of terpenic diesters, in particular the pinates, as extremely low-temperature lubricants for turbo-jet engines, instruments, machine guns and aviation and ordnance greases.

The objective of this research was therefore the development of a feasible method for the synthesis of pinic acid using as the raw material, alpha-pinene, which is the major constituent of turpentine. The general instability of the pinene molecule eliminates the use of many of the general oxidizing agents and thus a thorough study was initiated of a number of suitable agents in order to effect the desired transformation. It was found that the major product obtained in the liquid phase catalytic oxidation by means of oxygen was verbenone; this ketone, upon further oxidation, yielded acids, which are structurally different from those desired. The use of hypochlorous acid resulted in the formation of a pinene monochlorohydrin; this compound, however, is extremely susceptible to rearrangement upon further oxidation. When peracetic acid was employed, high yields of pinene oxide were effected, together with substantial amounts of the monoacetate; the latter was then subsequently converted to pinene glycol.

The liquid phase reaction of alpha-pinene with aqueous potassium permanganate resulted in the formation of pinonic acid, which, when subjected to further oxidation with sodium hypochlorite yields pinic acid. A thorough study of the important variables established the optimum conditions as: temperature, 14°C; reaction period, 4 hours. The reaction is best promoted by the stoichiometric proportion of potassium permanganate and the use of ammonium sulfate as a neutral buffer salt. The optimum total yield of keto acid is 65 mol percent while 85-86 mol percent pinic acid is realized. A method is presented for the recovery of non-acidic compounds and recycling of these materials. The reaction was found to be of the pseudo second order and unidirectional under the conditions that were employed.

A preliminary process flow sheet has been worked out and an estimate was made of the cost of building and operating a plant producing a total of 1,000,000 pounds per year of pinic acid. 165 pages. $2.06. Mic 56-1754

RECOVERY OF ACONITIC ACID FROM MOLASSES

(Publication No. 12,353)

Ernest A. Regna, D.Ch.E.
Polytechnic Institute of Brooklyn, 1955

The research investigation was conducted to recover aconitic acid in high yields from cane sugar molasses. The experimental section of the dissertation is divided into three parts:

III-B Methanol Precipitation Process

A process was designed to precipitate more than 90% of the available aconitic acid from cane sugar molasses by treating with lime, calcium chloride and methanol. The variables studied for maximum precipitation were:

1. Effect of pH of molasses,
2. Optimum concentration of calcium chloride in molasses,
3. Effect of temperature and time of reaction,
4. Effect of concentration of methanol in molasses.

The optimum conditions thus determined were tested on three molasses; in each case over 90% precipitation was obtained.

III-D Methyl Isobutyl Ketone Extraction on Molasses

Mutual solubility and tie-line data were obtained for the system aconitic acid-methyl isobutyl ketone-water. Extraction on monocalcium aconitate solutions in water, acidified with concentrated H_2SO_4 or H_3PO_4 were studied prior to extraction on acidified molasses. The variables studied for extraction of aconitic acid from acidified molasses included:

1. Water dilution of molasses for maximum phase separation,
2. Effect of percentrifuging acidified molasses prior to extraction to remove precipitate and assure maximum phase separation,
3. Effect of H_2SO_4 concentration in molasses on the distribution of aconitic acid between solvent and water in the molasses.

The acid concentration was found to correlate with the ash content in the molasses. An acid to ash ratio of 1.0 gave maximum recovery of aconitic acid and phase separation. A compilation of distribution data of aconitic acid between solvent and water in acidified molasses was made and tested on a new molasses with good agreement.

III-E Methyl Ethyl Ketone Extraction on Molasses

Mutual solubility and tie-line data were obtained for aconitic acid MEK-water system. In attempts to approximate the molasses system, ternary data on aconitic acid-MEK-water in a 40% sucrose solution and aconitic acid MEK-water in a 60% solids synthetic molasses system were obtained. Actual data obtained showed that none of these systems could be applied. Ternary data were

obtained for aconitic acid-MEK-water in acidified molasses diluted to 60% solids. Three-stage and five-stage countercurrent extractions were made on different molasses to test the ternary data. Agreement was good and recoveries of aconitic acid over 90% were obtained. Decolorization of aconitic acid solutions obtained from the MEK extract was also studied.

Section IV of the dissertation includes preliminary plant designs for producing aconitic acid at the rate of 1,000,000 pounds per year by:

1. Methanol Precipitation
2. Solvent Extraction
3. Ion Exchange

Cost estimates based on these plant designs were made and the cost of producing aconitic acid was determined for comparison with an estimated cost for the present commercial process. The solvent extraction process was found to have the lowest cost among the methods considered. 208 pages. $2.60. Mic 56-1755

ENGINEERING, ELECTRICAL

DIFFRACTION OF SURFACE WAVES BY A SEMI-INFINITE DIELECTRIC SLAB

(Publication No. 12,495)

Carlos Manuel Angulo, D.E.E.
Polytechnic Institute of Brooklyn, 1955

The diffraction of a surface wave by a semi-infinite dielectric slab of finite thickness in free space is discussed. The discontinuity at the end of the slab is treated as the junction of an open dielectric-filled waveguide and a free-space waveguide.

First, the spectrum of the dielectric waveguide is found. Then, variational expressions are set up as equal to the terminal admittance and the terminal impedance representing the effect of the discontinuity on the surface wave. These variational expressions are minima for the exact fields at the discontinuity plane, therefore, a reasonable assumption for the field at the discontinuity provides upper and lower bounds for the exact value of the terminal admittance presented by the discontinuity.

A variational expression is established as equal to the transfer impedance coupling the surface wave to one of the modes of the continuous mode spectrum associated with the free-space waveguide. The synthesis of all the modal components yields the radiated electromagnetic field at any point in the free space.

The terminal impedance and forward radiation patterns are plotted for $\epsilon = 2.49$ as functions of $\alpha = 2n(\frac{2d}{\lambda})$ on the variational assumption that the fields at the discontinuity are those associated with the surface wave. (2d is the thickness of the slab and λ is the free-space wavelength of the excitation.)

In other problems, of a similar nature to the one discussed in this dissertation, the finding of the mode spectrum presents extraordinary difficulties while the propagation wave-number can always be found easily by experiment. With this consideration in view, the terminal admittance is computed in our problem, on the variational assumption that the fields at the entire plane of the discontinuity have the same functional variation that the surface wave outside the dielectric and far from it. Unfortunately the results do not warrant this approximation in the frequency region of practical interest.

152 pages. $1.90. Mic 56-1756

A TRANSISTOR VOLTAGE ENCODER

(Publication No. 12,496)

Franklin H. Blecher, D.E.E.
Polytechnic Institute of Brooklyn, 1955

Electronic computers are a natural application for transistors because of their reliability, small power consumption, and small size. This paper describes the application of junction transistors to precision circuits which are used in analogue computers and analogue to digital converters. The three basic circuits which are used in these systems are a summing amplifier, an electronic integrator, and a voltage comparator. The transistor circuits are combined into a voltage encoder for translating analogue voltages into equivalent time intervals. This circuit is particularly useful for converting analogue information (in the form of a DC potential or an angular shaft position) into the binary digital code for processing in a digital computer.

The summing amplifier is used for adding a multiplicity of input voltages with an accuracy of at least one part in 5000. The maximum output voltage range, limited by transistor collector voltage restrictions is $\pm$ 25 volts. The amplifier has 80 db of negative feedback at DC with a descending asymptote of 8 db per octave which permits full accuracy to be attained in less than 500 microseconds. By the use of an automatic zero set (AZS) circuit the accuracy of the summing amplifier is maintained throughout a temperature range of $0^{\circ}C$ to $50^{\circ}C$. The zero set circuit is essentially a slow acting servo which is capable of detecting very small amounts of DC drift in the summing amplifier and correcting for it. Two types of AZS circuits are described; one circuit uses a mechanical chopper for sensing the DC drift while the second circuit uses a magnetic amplifier.

A theoretical analysis of the summing amplifier is given with particular emphasis placed on the problem of stabilizing the negative feedback. It is pointed out that when examining the stability of transistor feedback amplifiers, it may be desirable to use the loop-current transmission instead of the loop-voltage transmission.

The electronic integrator is used to generate a voltage ramp which is linear to within one part in 8,000. By means of an AZS circuit using a magnetic amplifier, the slope of the voltage ramp is maintained constant to within one part in 8,000 throughout a temperature range of $20^{\circ}C$ to $40^{\circ}C$. Although the integrator has been designed specifically for application in the voltage encoder, it can readily be modified for application in an analogue computer.

The voltage comparator is an electrical device which indicates the instant of time an input voltage waveform

passes through a predetermined reference level. The transistor voltage comparator has an accuracy of ± 5 millivolts throughout a temperature range of 20°C to 40°C.

The summing amplifier, the integrator, and the voltage comparator are assembled into a voltage encoder. The encoder can translate an analogue input voltage into an equivalent time interval with an accuracy of at least one part in 2,000. The accuracy is maintained throughout a temperature range of 20°C to 40°C.

240 pages. $3.00. Mic 56-1757

SUBHARMONIC RESPONSES OF THE FERRORESONANT CIRCUIT

(Publication No. 12,345)

Egon Brenner, D.E.E.
Polytechnic Institute of Brooklyn, 1955

The responses of a series R-L-C circuit with nonlinear inductance, subjected to periodic voltages, are analyzed to determine conditions for subharmonic response. The effect of hysteresis in the iron and of large nonlinearity is studied on the basis of idealized coil characteristics. Normalized parameters for hysteresis loop width and saturation flux linkages are introduced in connection with coercive force, capacitance, impressed frequency and impressed voltage amplitude. The occurrence conditions for the various types and orders of subharmonic responses are then derived on the basis of the idealizations. Two types of subharmonic and fundamental frequency responses are predicted: symmetrical and unsymmetrical describing whether the response has half wave symmetry or not. Since the idealizations sectionally linearize the problem, algebraic conditions between the loop width and the loop height parameters determine regions for these various responses. The idealizations are examined critically on a theoretical basis and experimental confirmation is obtained, verifying the occurrence of the various types and orders of subharmonics in accordance with the predicted response regions and waveforms, and for the predicted order of magnitudes for the parameters.

82 pages. $1.03. Mic 56-1758

A REDUCED-BANDWIDTH TELEVISION SYSTEM

(Publication No. 12,501)

Sid Deutsch, D.E.E.
Polytechnic Institute of Brooklyn, 1955

Short-wave transmission and tape recording of television pictures requires a bandwidth of 50 kc/sec instead of the conventional 4 mc/sec. The object of the thesis is to achieve this bandwidth with minimum degradation of picture quality, and with minimum circuit complications and cost.

Seven methods of reducing bandwidth are examined in detail. These are 1. reduced horizontal resolution; 2. reduced vertical resolution; 3. reduced field frequency; 4. increased interlacing ratio; 5. reduced retrace time ratios; 6. dot interlace; and 7. quantization and coding.

The first four methods are examined analytically, and an experimental system is tested having a bandwidth of 100 kc/sec. This system employs reduced resolution, vertical scanning, a field frequency of 20 cycles/sec, an interlacing ratio of 4 to 1, and a line frequency of 1125 cycles/sec.

A quantization and coding unit is used to reduce the 100 kc/sec signal to 50 kc/sec. At the receiver, a decoding unit brings the signal back to 100 kc/sec.

Photographs of various waveshapes and pictures are presented. As a result of the tests, it is concluded that 1. the 100 kc/sec picture has real entertainment value, despite reduced resolution, flicker, line drift, and break-up due to motion; 2. quantization and coding is not practical for this application because of a random dot fluctuation effect introduced by the sampling process. Instead, a 50 kc/sec system is suggested having reduced resolution, a field frequency of 20 cycles/sec, an interlacing ratio of 5 to 1, and a vertical line frequency of 676 cycles/sec.

177 pages. $2.21. Mic 56-1759

EXTENSION OF THE TRANSFER-FUNCTION CONCEPT TO CLASS II COMPENSATORS FOR AUTOMATIC CONTROL SYSTEMS

(Publication No. 16,560)

Gordon John Murphy, Ph.D.
University of Minnesota, 1956

The use of transfer functions in describing the flow of data through "d-c" control systems is reviewed, and it is pointed out that the theoretical basis for this use of the transfer-function concept is sound. The use of transfer functions in the analysis of "a-c" control systems which employ phase-sensitive detectors, Class I compensators, and modulators is mentioned. The facts that this practice is not well founded in theory, because of the non-linear devices involved, and that the results thus obtained are of limited value are stressed.

The discussion in the literature of the use of transfer functions in the study of "a-c" control systems which employ Class II compensators is mentioned, and the conclusions drawn in these treatments of the problem are presented. Presently used methods of analyzing such systems are discussed in detail.

The inaccuracy inherent in these methods is revealed by means of an analysis of the operation of a typical two-phase control motor, subject to the customary assumptions of large rotor resistance, linearity of the magnetic circuit, negligible exciting current, and negligible effect of electrical transients. This analysis reveals that the conventional transfer function for a two-phase motor is in error in that it neglects the decrease in stall torque with deviation from a time-quadrature relation between the reference voltage and the control voltage. It is shown that the developed torque, which is usually expressed as

$$T = K_M V_c - C_M \frac{d\theta_m}{dt}, \qquad (1)$$

where V_c is the amplitude of the control voltage and $\frac{d\theta_m}{dt}$ is the motor speed, is more correctly expressed as

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

$$T = K_M V_c \sin \phi - C_M \frac{d\theta_m}{dt}, \qquad (2)$$

where K_M, V_c, C_M, and $\frac{d\theta_m}{dt}$ are defined as in (1) and where ϕ is the phase difference between the reference voltage and the control voltage.

A method of describing the performance of a Class II compensator with the aid of transform theory is presented. This method, which involves neither the approximations nor the unsound use of $\sqrt{-1}$ inherent in previously employed methods, results in the development of an a-c transfer function which is uniquely determined by the conventional transfer function of the device and the phase of the error-transducer excitation relative to the reference excitation. Thus it is shown that the a-c transfer function of a Class II compensator may be written in the form

$$G_c(s) = R\ e^{j\gamma}\ G(s+j\Omega), \qquad (3)$$

where G(s) is the conventional transfer function of the compensator, Ω is the carrier frequency, γ is the deviation from $\frac{\pi}{2}$ of the phase difference between the reference excitation and the error-transducer excitation.

The use of the a-c transfer function in the analysis of control systems is explained, and, in particular, the graphical determination of the a-c frequency-response function is illustrated. Finally, the dependence of this frequency-response function upon the carrier frequency is discussed, and it is shown that

$$\frac{dG_c(s)}{d\Omega} = Jm\ e^{j\gamma}\left[G(s+j\Omega)\frac{d\gamma}{d\Omega} + G'(s+j\Omega)\right]. \qquad (4)$$

81 pages. $1.01. Mic 56-1760

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF FERRORESONANT CIRCUITS

(Publication No. 12,352)

Mustafa Nuri Parlar, D.E.E.
Polytechnic Institute of Brooklyn, 1955

In the first part of this dissertation, the nonlinear characteristics of the iron core reactors are investigated. Review of well-known methods of representations led to a new way of representing the multi-valued nonlinearity characteristics of the iron cores by means of the active and passive linear networks. The active and passive equivalent circuits of the iron cores explain in part the existence of the different natural modes of oscillations in ferroresonant circuits.

In the second part, the series ferroresonant circuit is analyzed with the aid of well-known classical methods as discussed briefly in the text. The well-known frequency response and amplitude response relations are derived and the results indicated by means of plotted curves. The probable and practical applications of the ferroresonant circuits are discussed.

In the last part, the effect of the hysteresis on the volt ampere characteristic is shown, which, with the stability consideration, explains the existence of the subharmonics of the first kind. This forms the major contribution of this work. The dissertation proposes the division of the subharmonics into two different kinds. The subharmonics of the first kind depend mainly on the hysteresis, initial permeability and on the initial conditions. The subharmonics of the second kind depend only upon the value of the excitation force. The experimental investigation followed very closely the qualitative theoretical work. The two kinds of the subharmonics are discussed in detail, and several modes of the two kinds of subharmonics are shown.

146 pages. $1.83. Mic 56-1761

THE DETECTION AND PHASE DETERMINATION OF SIGNALS IN ADDITIVE AND MULTIPLICATIVE NOISE

(Publication No. 12,520)

Herbert Sherman, D.E.E.
Polytechnic Institute of Brooklyn, 1955

The methods of statistical hypothesis testing are employed to determine filter designs for the detection and phase determination of signals corrupted by stationary correlated and uncorrelated additive and multiplicative noise. Multiplicative noise arises from a random perturbation of signal amplitude as may occur in radar echoes and tropospherically or ionospherically scattered signals.

For completeness, as a check, and for a demonstration of the facility of the method, hypothesis testing is used to derive already known filters for signals in uncorrelated and correlated additive noise in addition to new filters for detection and phase determination of signals perturbed by correlated and uncorrelated multiplicative noise. Because the method of hypothesis testing leads naturally to a specification of the impulsive response of the filter, the conditions for physical realizability can be stated for the above filters as well as for a phase determining filter for signals in correlated additive noise.

The success of the optimum phase determining filter is numerically compared in performance with a "center of area" phase detector operating on a representative signal.

By squaring the received signal, the optimum received signal treatment in the presence of uncorrelated multiplicative and additive noise can be met by a linear filter. This result suggests a general statement of the conditions on the probability density distributions of uncorrelated signals in noise which lead to linear filters after raising the received signal to a power.

The conditions under which minimum "distance" in sample space and cross-correlation become synonomous are brought out for the case of phase determination. The significance of signal treatments is interpreted in a geometrical analog to define the conditions on the optimum filter and their significance in terms of the probability of successful and unsuccessful signal interpretation.

Optimum filters suggest the choice of optimum transmitted signals for phase determination. Where impulsive signals become impractical because of peak power limitations, and increased signal energy is desired, methods are suggested for designing error detecting and correcting binary and ternary codes as optimal signals for transmissions designed to secure phase discrimination. These methods are illustrated by a number of binary and ternary code combinations. 181 pages. $2.26. Mic 56-1762

ENGINEERING, INDUSTRIAL

DEVELOPMENT AND TESTING OF AN ELECTRONIC METHOD FOR DETERMINING ACCELERATION, CONSTANT VELOCITY, AND DECELERATION OF BODY MOTIONS

(Publication No. 16,626)

Jay Goldman, Sc.D.
Washington University, 1955

Chairman: G. Nadler

Time standards (required performance times for operations) can be used in all branches of Industrial Engineering as well as other fields. Many measurements must be made to obtain a time standard. Practioneers indicate that operator performance is the most difficult. Many systems are employed in making this measurement, but the most tenable seems to be speed. Research shows that hand motions between two points are composed of three components (acceleration, constant velocity, and deceleration), which vary directly with performance levels. The purpose of this dissertation is the development of a device to accurately measure these components so that investigations can be undertaken relative to operator performance.

A number of possible measuring techniques were investigated and the direct Doppler effect (sound source motions relative to stationary receivers cause apparent frequency changes which vary directly with the source velocity) with ultrasonic sound radiations was selected since it presents the fewest formidable obstacles. The operating frequency (20 K.C.) and maximum velocity limit (10 fps) were then selected.

In the final design of the "Universal Operator Performance Analyzer and Recorder" (UNOPAR), a generated 20 K.C. signal is emitted by a speaker, which is attached to a body member. From the receiver (microphone) the signal (20 K.C. ± Doppler signal) is sent to a converter whose output is a D.C. voltage (magnitude proportional to input frequency). This D.C. voltage is filtered (remaining input pulse removed) and sent to a velocity amplifier and recorder. This voltage is proportional to speaker motion velocity since it is directly related to Doppler difference frequency which is related to speaker velocity through the Doppler effect. The D.C. voltage is also sent to an electronic differentiator (output is the derivative of input) and then to the acceleration recorder.

A ± 2g Accelerometer was chosen as the standard against which to test UNOPAR. Test motions (transports between two points) were restricted to one plane due to the difficulty of obtaining an accurate two or three plane measuring criterion. The test was carried out, using a one plane pick-up, in an anechoic chamber, (eliminate reflected sound moves). Individual tests were run for both velocity, and acceleration and deceleration.

The results indicate high correlations between: (1) the individual velocity (.9939 average) and acceleration (.9630 average) curves of UNOPAR and Accelerometer, (2) peak values of velocity (.9981) and acceleration (.9830), and (3) total elapsed time per test motion of velocity (.9920) and acceleration (.9880). The standard deviation of per cent difference between UNOPAR and Accelerometer was computed for peak velocity (1.08%), peak accelerations (2.174%), and total times of individual velocity motions (1.06%), and acceleration motions (2.79%).

On the basis of these results it can be safely concluded that UNOPAR accurately measures acceleration, velocity and deceleration. Displacement and position information can be obtained by electronically integrating the velocity voltage. Construction of two identical channels and computer will completely solve the problem of measuring three dimensional motions.

UNOPAR will help determine the standard level of operator performance as well as measure performance accurately. It will help to accurately describe methods, measure differences between methods, determine methods changes, produce information about motions, motion patterns, and motion paths, investigate differences between operators, and aid the entire time study procedure. It will also help explore the uses and limitations of standard data systems. UNOPAR will provide information about human performance which is needed in many other fields.

130 pages. $1.63. Mic 56-1763

ENGINEERING, MECHANICAL

AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF HEAT TRANSFER BY FORCED CONVECTION IN TURBULENT FLOW FOR AIR, CARBON DIOXIDE AND HELIUM (A THESIS IN THREE PARTS)

(Publication No. 16,449)

Jacobus M. Botje, Ph.D.
Purdue University, 1956

Major Professor: M. J. Zucrow

Document I
AN EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER BY FORCED CONVECTION IN TURBULENT FLOW FOR AIR, CARBON DIOXIDE AND HELIUM

The coefficients of heat transfer and of fluid friction for air, carbon dioxide, and helium were determined experimentally, for large differences between the average temperatures of the flowing gas and the surrounding wall. Experiments were conducted with turbulent flow for both cooling and heating of the gas.

The pertinent variables were varied over the following ranges for cooling of the gas:

a. average bulk temperature of the gas from 1055 R to 2140 R;

b. average temperature of the inner wall of the test section from 585 R to 1200 R;

c. static pressure of the gas, 50 and 200 psia;

d. the Reynolds number, Re_b from 14,000 to 115,000;

and for heating of air:

a. average bulk temperature of the gas from 580 R to 650 R;

b. average temperature of the inner wall of the test section from 1060 R to 2012 R;

c. a static pressure of the gas of 100 psia; and

d. the Reynolds number Re_b, from 52,000 to 189,000.

The experimental results have been compared with the values for the heat transfer parameters predicted from theoretical considerations. It is shown in this thesis that the discrepancies between the experimental results and the predicted values for the heat transfer parameters are due partly to the development of the thermal boundary layer in the test section and in part to the gradient of the temperature of the inner wall of the test section in the direction of flow.

Document II
AN ANALYTICAL EVALUATION OF THE COEFFICIENTS OF HEAT TRANSFER AND FRICTION FOR AIR, CARBON DIOXIDE AND HELIUM IN INCOMPRESSIBLE TURBULENT FLOW

The differential equations for non-isothermal turbulent flow of gases through constant area tubes with heat transfer have been solved numerically employing the values for the physical properties of air, carbon dioxide and helium. From the resulting velocity and temperature profiles values for the Nusselt number, the Reynolds number and the Fanning friction factor have been computed for selected values of the parameter β. The Nusselt numbers for the case of heat addition are lower and those for heat extraction are higher than the Nusselt numbers for isothermal flow at corresponding values for the Reynolds numbers. The results are presented in tabular and graphical form.

Document III
HEAT TRANSFER AND FLUID FRICTION IN GASES
A SURVEY OF THE LITERATURE

This document presents a review of the literature pertaining to forced convective heat transfer for gases in turbulent flow. 383 pages. $4.79. Mic 56-1764

PART I: ANALYSIS OF TIP-CLEARANCE FLOW IN TURBOMACHINES.
PART II: EXPERIMENTAL INVESTIGATION OF TIP-CLEARANCE FLOW IN CASCADES.

(Publication No. 16,051)

Wen Wu, D.M.E.
Polytechnic Institute of Brooklyn, 1956

The purpose of this work is to present a basic study of the "Tip-Clearance Flow" phenomena in turbomachines. The work consists of Part I, theoretical analysis, and Part II, experimental investigations.

In Part I, a theoretical analysis is made on the flow phenomena across the blade tip-clearance space. The fluid is considered to be viscous and incompressible. The basic equations of motion and continuity are expressed with respect to a cylindrical coordinate system rotating with the blade at the same speed.

Simplified equations are then obtained by an order-of-magnitude analysis. Three cases are studied; one for thick blade tip section with low Reynolds number, one for thick blade tip section with high Reynolds number and one for very thin blade tip section with high Reynolds number. In the first case, an analytical expression for the velocity components inside the tip-clearance space are obtained. The pressure distribution on the tip-end surface is governed by a Laplace equation. In the second case, an approximate solution is obtained by assuming two polynomials for the velocity components. In the third case, a simple relation is established between the circumferential velocity component and the pressure difference between the two sides of the blade.

Three methods of solution are discussed for the solution of the Laplace equation of the pressure distribution. The first one is the relaxation or matrix method. The other two involve Joukowsky transformation to convert the tip-end sectional surface into either a true circle or a near circle.

Finally, an expression for the mass flow across the tip-clearance space is obtained.

In Part II, a rectilinear cascade was constructed with flow conditions simulating those in an axial compressor. Details of equipment and test procedure are described. The static pressure distribution on the blade surface and the total (stagnation) pressure of the outlet fluid are measured.

The tip-clearance effect on pressure distribution on the tip-end surface and pressure loading at various stations on the blade surface are determined from the experimental results. The tip-clearance effect on the outlet total pressure is also recorded and studied. Then the moving-wall effect on these quantities is studied. Finally, a smoke visualization experiment is conducted.

140 pages. $1.75. Mic 56-1765

ENGINEERING MECHANICS

A METHOD FOR THE CALCULATION OF STRESSES AND DEFLECTIONS IN TRANSVERSELY LOADED PLATES UNDER BOUNDARY CONDITIONS OF ELASTIC SUPPORT

(Publication No. 12,349)

Samuel Julian Fuchs, Ph.D.
Polytechnic Institute of Brooklyn, 1955

A solution is presented for the problem of the transversely loaded plate, especially rectangular, supported on beams along all the edges, for general values of parameters expressing the flexural and torsional rigidities of these beams. Most of the solutions in the literature apply to limiting values of these parameters. As far as is known to the author, the more general problem of the present paper had not been treated previously.

The formal solution comprises an infinite series of terms with constant coefficients conforming to the boundary

conditions, as in most solutions of plate problems in the literature. However, the determination of these constants, by the method of analysis herein, involves in general the solution of sets of simultaneous linear equations. These constants, once obtained for assigned values of the parameters, and for assigned plate proportions, serve thereafter for computation of stress and deflection coefficients for various positions in the corresponding plates. The convergence of the constants used to evaluate deflections is very rapid. The constants used in expressions for shear and moment occur in combinations of terms the convergence of which, in extreme cases, is relatively slow. However, no especial difficulty was encountered in the numerical cases involving these constants.

The constants are obtained by means of operational matrix formulas derived by the method provided. For convenience of presentation, the method is applied explicitly to the derivation of a matrix formula for the less general problem of simple, flexural support (under uniform load). The important problem of the clamped plain plate, corresponding to an idealized beam with vanishing flexural rigidity and with torsional rigidity approaching infinity, requires a more extended treatment by the same general method. 77 pages. $1.00. Mic 56-1766

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THE MIXING OF TWO HOMOGENEOUS STREAMS

(Publication No. 12,514)

Luigi G. Napolitano, Ph.D.
Polytechnic Institute of Brooklyn, 1955

A theoretical and experimental investigation of the mixing of two streams with different velocities in the presence of axial pressure gradients has been carried out.

In the theoretical work, new methods of analysis based on boundary layer theory have been developed. One method is applicable to the case of two infinite streams with the same prescribed axial pressure gradient. The analysis has been carried out for the incompressible flow case. By suitably chosen transformations of both independent and dependent variables a second order non-linear partial differential equation of the parabolic type is obtained for the laminar case. A series solution in terms of a parameter involving the initial velocities is given. The first approximation is shown to be the exact solution for the small perturbations case. The extension to the compressible case has been examined and the Stewartson transformation has been applied to mixing problems. The impossibility to relate compressible and incompressible mixing of free streams in the presence of axial pressure gradients has been proved. In turbulent flow, Reichardt's theory of turbulence has been used. By suitable transformation of variables and proper assumption for the coefficient of eddy kinematic viscosity it has been shown that the equation of two dimensional turbulent mixing is identical to that of the laminar case. Two characteristic constants are left to the experimental determination for the complete solution of the problem.

A second method of analysis is based on the integral solution of the boundary layer equations. It is applicable to the case of compressible mixing of two streams with the same stagnation enthalpy in a channel of arbitrary cross sectional area distribution. The possibility of extending the method for the case of streams with different stagnation enthalpy is indicated. The pressure variation in the axial direction is found from the solution if the channel shape is prescribed. The method is based on the boundary layer equations in the region where the mixing is strong and on conditions of mass, momentum, and energy conservation in the essentially undisturbed or unmixed flows.

In the experimental program a special wind tunnel has been designed and constructed. In this tunnel two streams, one supersonic and the other either subsonic or supersonic can be established in a two-dimensional channel of either constant or varying area. Mach numbers and geometry at the origin of mixing can be easily varied. Preliminary tests in this tunnel have been carried out for a supersonic stream's Mach number of 1.6. The results thereof are presented here.

The main conclusion which can be drawn from the theoretical result is that an axial pressure gradient has significant effect on the mixing process. Both methods have been shown to yield exact agreement with known solution of the vanishing axial pressure gradient case. From the experimental program, it has been shown that under certain conditions the mass flow through the secondary stream, that is the stream which can be either subsonic or supersonic, can change greatly with a small change in exhaust conditions of combined streams. This sensitivity may be related to the phenomenon of inlet buzz. Two different types of choking were found to occur depending on the exhaust conditions. The difference between this type of choking and the one-dimensional choking of single streams has been pointed out and discussed.

147 pages. $1.84. Mic 56-1767

AXIALLY SYMMETRIC, VARIABLE THICKNESS CIRCULAR PLATES ON ELASTIC FOUNDATIONS

(Publication No. 16,630)

Norman Herbert Zimmerman, Sc.D.
Washington University, 1956

Chairman: Dr. G. Mesmer

The differential equation for the deflection of the axially symmetric, variable thickness circular plate on an elastic foundation has been derived and expressed in terms of non-dimensional parameters. For the case of the thickness varying with r^m, power series solutions have been obtained using the method of Frobenius. For the exponential thickness variations, i.e. in accordance with e^{r^m}, a solution technique is developed using a method of successive approximations. This technique is demonstrated for the exponential family e^{r^2} obtaining a power series solution in terms of a "relative stiffness parameter". The flexural stresses are obtained in the usual manner from the plate deflection.

83 pages. $1.04. Mic 56-1768

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ENGINEERING, METALLURGY

A STUDY OF THE PHYSICAL AND CHEMICAL CHANGES OCCURRING IN A BED OF IRON OXIDE PARTICLES DURING THE SINTERING PROCESS

(Publication No. 16,570)

Richard D. Burlingame, Ph.D.
University of Minnesota, 1955

Adviser: T. L. Joseph

Sintering of fine iron oxides has been commonly practiced in the steel industry for almost fifty years, but so little fundamental research has been done in this field that our understanding of the process is quite rudimentary. Most of the basic research already performed has dealt with sinter constitution, but these studies do not provide a knowledge of the processes which lead up to the fusion point. The aim of the present investigation was to shed some light upon the over-all physical and chemical changes which take place during sintering.

Detailed study of the instantaneous changes occurring in a sintering bed became possible after devising methods to abruptly arrest the sintering and to reveal the reaction zone pattern within the partially-sintered bed. The combustion was stopped with a short nitrogen quench, and the fifty-pound charge was removed from the sintering chamber, in toto, by withdrawing the insulated basket which contained the mixture. Dissection procedures were worked out which permitted immediate, accurate sampling of all zones in the bed for subsequent chemical analysis. These techniques also revealed the entire zone pattern for photography.

Microscopic examination of the partially-sintered bed became feasible after developing resin-impregnation procedures for binding the granular portion of the charge and the sinter cake together in one coherent mass. The sectioning and mineralographic techniques that followed provided specimens for high-magnification study, with special attention being given to the zone of combustion and sinter formation.

The investigation of the physical and chemical changes which take place during sintering was applied to a mixture of iron oxides representative of commercial American practices. The work was confined to a study of the effects of varying the fuel content at a constant air flow rate typical of practice. The zone pattern established during sintering was pictured and described, and for each percentage of fuel, graphs were presented which showed the variations in chemical analysis across the entire bed for several important constituents. Actual size and magnified photographs were obtained of the peak-temperature transition zone where the granual mixture is converted into a mass of coherent sinter. A summary of the over-all sintering process was included to integrate the experimental results.

81 pages. $1.01. Mic 56-1769

ENGINEERING, SANITARY AND MUNICIPAL

DISPERSION AND AGGREGATION OF SEWAGE COLLOIDS AND HYDRATION OF SEWAGE SLUDGES

(Publication No. 16,696)

Eugene Weisberg, Ph.D.
Rutgers University, 1956

This study deals with the effect of various types of agitation on the dispersion and aggregation of sewage colloids (Part I); and the hydration or bound water of activated sludge, raw sludge, digested sludge, trickling filter slime, and non-conventional activated sludges such as modified, activated aerated, and step-aerated sludges (Part II). The relationship between bound water and bulking of activated sludge is emphasized.

The separation of the colloids from sewage involves a series of operations consisting of settling, controlled centrifugation, and ultrafiltration. The colloids are defined on the basis of particle size and represent those particles between 1 micron and 1 millimicron. The types of agitation studied are the Waring Blendor, pumping, shaking, and stirring. Both the Waring Blendor and pumping increase the colloidal content. The source of the increase is the settleable solids and the increases range from 10% to 39% of the settleable solids. There is, however, no direct relationship between the settleable solids concentration of a sewage and the increase in colloidal content. Shaking and stirring cause aggregation of the colloids in a non-sterile sewage or in a non-sterile colloidal-soluble fraction. The presence of coarser particles has no effect on colloidal aggregation. There is no aggregation or flocculation of colloids in a sterilized sewage. This illustrates the prime importance of biological agents in colloidal flocculation.

Bound water determinations by the dilatometric method indicates that all sewage sludges contain bound water. The bound water, expressed as a percent of the sludge volatile solids, are 50 for raw sludge, 60 for digested sludge, 93 for trickling filter slime, and 100 for activated sludge.

It is possible to distinguish two types of bulking. One is a Zooglea type sludge with high bound water; the other is a sludge composed of Sphaerotilus filaments in which the bound water is not higher than that of a good settling sludge. Bulking of the Zooglea type can be produced by feeding colloidal-soluble sewage solids to a sludge at a sludge age of 1 and 2 days. There is no bulking at sludge age 3. There is high sludge buildup due to protoplasmic growth, and high sludge oxygen utilization associated with a bulky sludge produced by feeding colloidal-soluble solids.

Under otherwise similar conditions, bulking is not produced when a sludge is fed settleable solids at sludge ages of 1 and 2 days.

A Sphaerotilus bulky sludge can be produced with a high carbohydrate feed to sludge ratio at a high carbon to nitrogen ratio.

The cause of the bulking of the Zooglea type is believed due to the decrease in the sludge density due to the high bound water. In Sphaerotilus bulking the failure of the sludge to settle is explained on the basis of the slow settleability and high volume occupied by the organisms due to their intertwining, filamentous nature.

The causes of bulking observed in activated sludge plants is discussed from the standpoint of sludge loading, type of feed, and oxygenation capacity as related to the requirements of Zooglea and Sphaerotilus organisms.

231 pages. $2.89. Mic 56-1770

FINE ARTS

A STUDY OF LIGHT AS A MEDIUM OF CREATIVE EXPRESSION IN THE VISUAL AND PRACTICAL ARTS

(Publication No. 16,607)

Harold Champion Simmons, Ph.D.
New York University, 1956

Chairman: Associate Professor George K. Ross

The Problem

The investigation is a study of light used creatively in the visual and practical arts. It explores the realm of color as a manifestation of light; of color and its relation to a total concept of light employed in the arts; of color not merely as a visual aspect of a surface, but as a synthesis and an interaction of light source, structural object, and observer. The study is concerned with two aspects of light employed creatively in the arts: (1) as a part of other media, and (2) as a separate medium.

Significance of the Study

One of the less examined areas furnishing creative possibilities to the artist is that of light in its various aspects and relationships to art. Yet, it is in this area that much of the future in art may lie. Educationally, there is an ever present need to fulfill the questing spirit that brings to fruition the potentialities of the intellect. Without a constant searching in the frontiers of knowledge and creative expression, education and culture loses its real meaning and becomes impotent. This study becomes a part of such a search.

Historical Background

Man has developed various concepts of light in relation to art. The study shows a definite evolution from the idea of light wholly dependent upon subject matter (as a part of it) to one where light assumes quite an independent status for creativity. Such an evolving concept is presented with substantiating evidence and illustrations, showing that it has been both consistent with and an integral part of man's cultural advance.

Procedure in Collecting Data

To secure worth-while historical data, the researcher collected only those data by well known authorities in the field, primarily from recent writers, since it is mostly the later writers who have the most objective and definitive concept of light. For this reason, only a few primary sources were sought. For the most recent and current activities, periodicals, newspapers, and journals were used.

The Results

The following were analyzed and found significant: (1) the tracing of how light was employed historically in the Western arts; (2) the ascertaining of the relationship between light and other media as a means of creative expression, and the demonstration of utilizing the same criteria for the creation of art with light as with any other art medium; (3) the indication of educational significances of the problem in institutions teaching commercial art on the professional level; (4) the suggestion of future potentialities of light as a medium of expression; and (5) the demonstration of the possibilities of the problem by the construction of a light display as a creative project.

Creative Display and Film

To show the possibilities, a creative project was constructed. The display was approximately 2 x 2½ x 2 feet. Included were various types of lighting, such as short and longwave ultraviolet and colored tungsten. These sources of light illuminate, in turn, various pigments painted on abstract designs. A motion picture (16 mm.) and 2 x 2 slides (35 mm.) were made of the display.

Conclusions

(1) Light can be a separate medium of expression for creativity in the arts; (2) light can become widely recognized and utilized as a means of creative expression in the future; and (3) light can have a more meaningful part in the appreciation of art.

Suggested Recommendations

There is much room for exploration in this area. In institutions teaching commercial art on the professional level there is a need to fully utilize light as part of the basic curriculum. What is needed is a "light" exercise to promote visual acuity. The development of such an exercise can fill a need too long unrecognized. An exercise or method to develop apperception in light is a fertile and practically untouched field for exploration.

284 pages. $3.55. Mic 56-1771

THE PLACE OF FOLKLORE IN THE CREATIVE ART OF MARK TWAIN

(Publication No. 16,394)

Ray William Frantz, Jr., Ph.D.
University of Illinois, 1955

This thesis is an attempt to show, through an examination of Mark Twain's travel books, historical novels, and those books conceived in the spirit of the Hannibal period (Pudd'nhead Wilson, The Mysterious Stranger, Tom Sawyer, and Huckleberry Finn), what folklore usage contributes to the artistic achievement of each book. The first chapter of the thesis traces the folklore influences in Twain's life and makes the point that they so permeated his nature that they easily found their way into his writing, almost, in fact, whenever he picked up his pen.

The travel books are filled with folk materials. Although upon occasion these materials are used seriously, sometimes serving as important touchstones to the culture of a strange land, they are more often used without plan as a kind of window dressing, an additional device for fleeting laughter. The historical novels show an advance in folklore usage over the travel books. Here folklore performs at least one important service to each book which is vital to the progress of the entire work. Especially is this true of A Connecticut Yankee, in which the Yankee is depicted entirely in terms of folklore.

As Mark Twain more and more conceived of his writing in terms of his Hannibal days, the period of his strongest and most lasting folklore impressions, he more and more employed this lore with increasing artistry. The books written in the spirit of this period reveal folk materials performing a greater variety of important functions in a given book than is true of any of his other work. Although this is clearly seen in Tom Sawyer, where folklore is indispensable to the entire story, Twain's greatest folklore achievement is Huckleberry Finn. In this book folk materials not only delineate character, supply important motivation, and heavily color the background, but also emerge as a structural device.

Mark Twain's use of folklore in his works has not received the attention it deserves. Some of his finest books would be husks of their present greatness if the folklore in them were stripped away. In many cases this lore, for Mark Twain, was a basic writing method. The importance of these folk materials is such that any considered evaluation of Twain's work or of his place in American literature must include this most vital aspect of his creative powers. 261 pages. $3.26. Mic 56-1772

THE ORIGIN AND DEVELOPMENT OF ETHNIC CARIBBEAN DANCE AND MUSIC

(Publication No. 16,360)

Lisa Lekis, Ph.D.
The University of Florida, 1956

The general purpose of this study is to trace the historical development of the ethnic dance and music of the Caribbean islands, and to examine its significance and importance from a sociological and anthropological point of view. Rather than considering specific dances and musical scores from a choreographic or technical standpoint, the function of dance as an integral part of the life of the people is used to demonstrate how a culture may be studied through the artistic manifestations of ethnic dance and music.

The study is divided into four parts. Part I consists of a discussion of the role played in the evolving patterns of the Caribbean by the three races which have been the dominant elements of the society of the West Indies. The aboriginal Indians, now extinct in the Caribbean islands, are the first people discussed by considering their background, the place of dance in Indian society and the possibility of vestigial Indian influences upon contemporary dance and music of the West Indies. The second racial element is Negro whose status in society and the effects of his heritage of slavery upon his contribution to dance and music are discussed. Last among the people of the Caribbean to be considered are the Europeans of various national backgrounds who colonized and settled the islands of this area.

Part II, entitled "The Significance and Function of Dance Among Afro-Caribbeans," traces the beginnings of the dance of this group to its African origin, and briefly explains the philosophy of the religious worship of the African tribes, and how the ritual function of dance and music associated with religion has been retained by Afro religious cults in the New World. A section is devoted to a discussion of the cultural and moral standards of African society as they differ from those of Europe and the United States, and the effects of these differences upon dance and music.

Part III is a group of chapters each concerned with a survey of dance and music in the individual islands of the Caribbean. Rather than presenting each dance as a separate entity, the subject is treated broadly, with dances considered according to their functions - ritual, secular or Carnival, their racial backgrounds, the extent of European influence, and as examples of religious syncretism. Treated in this manner are the islands of Cuba, the Dominican Republic, Puerto Rico, Trinidad, Jamaica, Haiti, the French West Indies, the Netherlands West Indies and the United States Virgin Islands.

Part IV contains a general summary of the importance of dance in the Caribbean countries, an outline of the difficulties and possibilities of dance and musical notation

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

and a short discussion of the probable future and destiny of Caribbean music and dance.

The paper concludes with a selected and annotated bibliography including sections dealing with the general and historical material on the Caribbean, noting especially items containing references to early dance and musical forms in the islands, a section devoted to a listing of African source materials which is not intended to be complete, but which offers references including at least some descriptive dance material of tribes represented today in the West Indies. A third section is made up of general works pertaining specifically to dance and music, not necessarily Caribbean, but of important use for those interested in the history and techniques of both dance and music.

Section IV of the bibliography is divided into sub-sections containing references for specific areas of the Caribbean, classified linguistically - the Spanish speaking islands, the English speaking islands, Haiti, and the other smaller groups including the French and Dutch West Indies and the Virgin Islands.

In addition to serving as a survey of ethnic dance and music, where and how they originated and evolved and their contemporary existence today, this study is intended to demonstrate how artistic manifestations such as dance and music can be used as an aid to an analysis of the content of a whole culture. 294 pages. $3.68. Mic 56-1773

GEOLOGY

PALEOZOIC STRATIGRAPHY OF THE TETSA-HALFWAY RIVERS AREA, NORTHEASTERN BRITISH COLUMBIA, CANADA

(Publication No. 16,180)

Dave Russell Kingston, Ph.D.
The University of Wisconsin, 1956

Supervisor: Professor Lowell R. Laudon

The thesis area was geologically unknown. All phases of fundamental geological research were employed to solve the regional and specific problems encountered, as well as for the initial determination of the time-rock units observed within the area. The reasons for the study of this region were to obtain composite stratigraphic sections, to correlate individual sections, and to discover regional facies changes through the examination of Paleozoic rock sections. In addition, it was desired to determine the age, thickness, lithology, and possible oil reservoirs of the rock units observed, and to study, in particular, the facies changes in rocks of Devonian age.

Composite stratigraphic sections were studied at seven locations throughout the thesis area, and Cambrian through Cretaceous age rocks were observed. No rocks of Pennsylvanian or Permian age were observed within the region. In addition, nine Devonian sections were examined and described in detail, with particular emphasis on the location and description of reefs. In the Redfern Lake area, a new formation was observed in rocks of Middle Devonian Age. Individual sections were correlated and regional facies changes observed. Potential oil reservoir rocks are tabulated in the thesis and described. The thesis area is compared with others in the Mackenzie River-Great Slave Lake region for stratigraphic correlation and interpretation of Late Devonian paleontology, sedimentation and historical geology.

The concept of a "facies fossil" is reviewed and compared with the time-accepted concept of a "(time) index fossil." The validity of the use of certain selected fossils as time guides is also considered. A new correlation based upon the facies fossil concept is postulated for the Devonian rocks of the Mackenzie River-Great Slave Lake region of which the thesis area is a part. Finally, the extent and nature of marine deposition and the historical sequence of events during the lower Late Devonian in the Northwestern Canada region is summarized.

130 pages. $1.63. Mic 56-1774

QUATERNARY STRATIGRAPHY OF THE LA SAL MOUNTAINS, UTAH

(Publication No. 13,770)

Gerald Martin Richmond, Ph.D.
University of Colorado, 1955

Supervisor: Professor Warren O. Thompson

The La Sal Mountains are located in southeastern Utah south of the confluence of the Colorado and Dolores Rivers on the eastern margin of the Colorado Plateau. They comprise three groups of laccolithic mountains that rise to altitudes as high as 13,000 feet.

The area contains an unusually complete stratigraphic record of Quaternary sedimentation, erosion, and soil development, which yields evidence for at least nine glacial episodes and intervening interglacial intervals. The Quaternary deposits are subdivided into four formations, on each of which is a stratigraphically distinct soil profile whose degree of development characterizes that formation. Younger formations overlap older formations, or lie on erosion surfaces that dissect them. Formations are subdivisible into members, on each of which is a soil profile whose degree of development does not characterize a particular member. Members comprise several genetically distinct lithofacies having mutually gradational or interfingering relations.

The oldest formation, the Harpole Mesa formation, consists of three members, the lower two of which comprise till, alluvial gravel, and eolian deposits. The upper member comprises eight lithofacies, including till and several

kinds of alluvial, colluvial and eolian deposits. The tills form sheet-like deposits on high interfluves and broad valley surfaces. Alluvial gravel of the lower member trends across present canyons. Similar very strongly developed soils occur on each member. Rarely distinguishable, they are jointly called the Spring Draw soil.

The Placer Creek formation consists of two members that comprise nine lithofacies, including till and various alluvial, colluvial and eolian deposits. The till forms two sets of lower canyon end moraines. A weakly developed soil, the Porcupine Ranch soil, is formed on the lower member where it is overlain by the upper member. A strongly developed soil, the Lackey Creek soil, is formed on the upper member and on deposits of the lower member that are not overlain by the upper member.

The Beaver Basin formation consists of two members that comprise ten lithofacies, including till, rock glaciers, and various alluvial, colluvial and eolian deposits. The tills form two sets of upper canyon end moraines. A weakly developed soil, the Pack Creek soil, is formed on the lower member where it is overlain by the upper member. A moderately developed soil, the Castle Creek soil, is formed on the upper member and on deposits of the lower member not overlain by the upper member.

The Gold Basin formation likewise consists of two members comprising ten lithofacies. The tills form two sets of small cirque moraines or rock glaciers. A very weakly developed soil, the Spanish Valley soil, is developed on the lower member. No soil, or only a faint humus, is formed on the upper member.

Each stratigraphically distinct soil grades from higher to lower altitudes through four soil facies or Great Soil groups, without change in relative development. This coincidence in relative development and relative stratigraphic position of soils is one of several criteria for correlating the Quaternary deposits of the La Sal Mountains with those of the San Juan Mountains, the Front Range, the Wind River Mountains, the High Plains of Kansas and Nebraska, and questionably with the drift sheets of the mid-continent region. A time-stratigraphic standard for the Rocky Mountain region is proposed.

The Quaternary stratigraphy of the La Sal Mountains demonstrates that a specific succession of geologic processes, presumably controlled by climate, dominated each glacial-interglacial cycle. During glacial intervals, widespread frost action, solifluction and glaciation caused stream regimen to change from erosion to coarse-grained alluviation. Eolian activity and fine-grained alluviation changing gradually to arroyo-cutting dominated late glacial and early interglacial time. Soil formation under conditions of essential slope stability followed. In late interglacial time stream erosion deepened and widened valley floors prior to the onset of the next glaciation.

287 pages. $3.59. Mic 56-1775

HEALTH SCIENCES

HEALTH SCIENCES, DENTISTRY

CEPHALOMETRIC STUDY OF THE HUMAN FACE FROM SERIAL ROENTGENOGRAMS: ANALYSIS OF GROWTH PATTERNS IN FIFTEEN INDIVIDUALS BETWEEN FOUR AND TWENTY YEARS

(Publication No. 13,768)

Ram Sarup Nanda, Ph.D.
University of Colorado, 1955

Supervisor: Professor Edith Boyd

Age changes in the proportions of the human face since the time of the renaissance have attracted the attention of, first, the artists, then the biologists, the anthropologists, and, lately, the orthodontists. The mode of development of malocclusion of the teeth and the disharmonies between dental and facial structures have been recognized to be essentially problems of growth and development.

The standardization of the technic of cephalometric roentgenography in the early thirties added a great impetus to the study of age changes in the face. This technic made possible the maintenance of serial cephalometric roentgenograms of a growing child. Since then the growth of the face has been studied chiefly by superimposing the successive head tracings from the roentgenograms using various anthropometric reference planes. In each of these studies, the plane used was assumed to be fixed. But areas of the skull do change; hence, these assumptions may produce spurious results.

The major objective of the present investigation was to devise a useful quantitative approach towards the analysis of the growth changes in the face. The data for the present study consisted of serial lateral cephalometric roentgenograms of ten boys and five girls between the ages of 4 and 20 years taken at 1- to 2-year intervals. All of the subjects were participating in the longitudinal growth studies at the Child Research Council, University of Colorado School of Medicine. Seven facial dimensions, i.e., sella-nasion, nasion-gnathion, nasion-prosthion, prosthion-infradentale, sella-gonion, gonion-gnathion and sella-gnathion, were measured. The growth pattern of each dimension was studied in terms of both its curve of growth and the curve of relative increment.

The growth curves of all the facial dimensions were typical of the general skeletal growth curves other than cranium, which had a neural type of growth. The curve for sella-nasion was a composite of neural and general body growth. Those of nasion-prosthion and infradentale-gnathion were modified in childhood by the successive processes of shedding of deciduous and emergence of permanent teeth. Analysis by the relative increment curves sharply emphasized the differences in the growth curves of the various dimensions. Circumpuberal spurts were consistently observed in all the dimensions, though the time of both the onset and the peak of the general circumpuberal rise was slightly different for each of the various

dimensions of the same child. Although a superficial examination of the curves of growth indicated that each dimension of the face has a relatively stable position in the group, the application of the more sensitive method of relative rate of growth showed that there were differences in the rate of growth from one dimension to the other. These differences were considered sufficient to change the form of the face.

Both the growth curves and the relative increment curves showed that the growth of the face tends to have circumpuberal maximum slightly later than the general body height. Also, the body height was found to complete its growth sooner than the face. In the small sample investigated, the outstanding sex difference observed was that the girls had relatively less facial growth than the boys during adolescence. 140 pages. $1.75. Mic 56-1776

HEALTH SCIENCES, PATHOLOGY

HODGKIN'S DISEASE AND ITS INTERRELATIONSHIPS WITH OTHER DISORDERS (PARTS I-V)

(Publication No. 16,569)

Clyde Johnson Dawe, Ph.D.
University of Minnesota, 1956

This study has five parts:

(1) A morphologic investigation of 636 cases of malignant lymphoma and leukemia, including 305 cases of Hodgkin's disease. Addition of Wright's-stained imprints to standard section methods in 151 cases permitted more accurate identification of cell types. A minority of lymphocytic and reticulum cell neoplasms showed anaplastic features comparable to those found in general neoplasia. Leukemic cases could not be distinguished morphologically from non-leukemic ones. Cells of the Sternberg-Reed family were considered the only neoplastic elements of Hodgkin's lesions. This cell series differentiates toward an abnormal analogue of the histiocyte, from a neoplastic stem cell closely resembling the hematopoietic reticular cell (hemocytoblast). In the sarcoma form of Hodgkin's disease, anaplasia was outstanding, and cells of the Sternberg-Reed group lacked very close similarity to any normal cell type.

(2) Search for intermixtures and transformations of cytologic types within individual cases revealed few convincing examples of these phenomena. "Acceleration" from a well-differentiated cell to a less-differentiated one of the same type was more common than directional change of differentiation.

(3) Histochemical studies describe the occurrence in Hodgkin's lesions of hyalin peri-vascular deposits having characteristics common to both amyloid and collagen, and similar to those found in rheumatoid arthritis, disseminated lupus, and other hyperglobulinemic states. "Fibrinoid" deposits occurred in some Hodgkin's lesions.

(4) Attempted transplantation of 24 lymphomas, including 13 of Hodgkin's disease, into 154 guinea pig anterior chambers resulted in uniform failure, regardless of prior animal radiation. One case of Ewing's sarcoma of bone grew for a period, differentiating this neoplasm from lymphoma.

(5) Of 297 lymphoma patients followed 15 years, 6.5% survived this period. Among 55 cases with clinically localized disease at onset, survival at 15 years was 24%. Although histologic type had a bearing on survival, the degree of localization at first treatment was more important.

425 pages. $5.31. Mic 56-1777

HEALTH SCIENCES, PUBLIC HEALTH

MEASUREMENT OF THE EFFECTS OF AGING AND NOISE STRESS ON HIGH FREQUENCY HEARING LOSS

(Publication No. 16,521)

Sidney Pell, Ph.D.
University of Pittsburgh, 1956

Exposure to certain occupational noises over a prolonged period of time is known to produce a permanent, nerve type of hearing loss, but there are widely varying opinions on what noise levels are hazardous. One of the difficulties encountered in attempting to measure the effect of noise stress on hearing acuity arises from the fact that the kind of hearing loss produced by acoustic trauma is very similar to that associated with the aging process. Both types of hearing loss are characterized by progressive elevation of hearing thresholds in the high frequencies and ultimate involvement of tones in the middle and lower range. It is the purpose of this thesis to study the effects of exposure to occupational noise levels up to 90 decibels, and to present a statistical model that separates, mathematically, the effects of aging and noise stress.

Measurement of hearing loss is based on the pattern of the audiogram. A system of audiogram classification is described which establishes criteria for five stages of high frequency hearing loss.

The material available for study consists of annual audiograms taken from 1947 through 1954 on 1,049 male employees of an arms plant. Five-year changes in the stage of high frequency hearing loss of the worse ear are analyzed in relation to the overall level of noise exposure, age, and the stage of hearing loss at the onset of the five-year period of observation. Employees who were exposed to noise levels between 75 and 90 decibels are compared with employees who worked in areas where the noise level was less than 75 decibels.

Statistical analysis of the data support the following conclusions.

1. The hearing acuity of persons with normal audiograms is affected by five years of exposure to occupational noise ranging from 75 to 90 decibels.
2. The hearing acuity of persons with Stage 1 high tone hearing loss is affected by five years of exposure to occupational noise of 85 to 90 decibels, but not by noise between 75 and 84 decibels.

3. The hearing acuity of persons with Stage 2 high tone hearing loss is not affected by five years of exposure to occupational noise up to 90 decibels.
4. Among employees exposed to noise stress who do advance to a higher stage over a five-year period, only a small percentage advance more than one stage.
5. High frequency hearing loss begins rapidly and proceeds more slowly in its advanced stages.
6. The damaging effect of noise stress diminishes with each successive initial stage.
7. Persons 45 years and over are more susceptible to traumatic hearing loss than persons below 45 years.

A statistical model is presented which separates, on a probability basis, the effects of aging and noise stress on high frequency hearing loss, and thereby provides a method of estimating the risk of incurring hearing loss as a result of noise exposure if aging had no effect on hearing acuity. When applied to the data used in the study, the model yields probabilities that are consistent with the findings listed above.

The probabilities indicated particularly striking effects of noise on the hearing acuity of the employees who were between 45 and 59 years of age and at Stage 1 hearing loss at the beginning of the five-year period. Among those who were exposed to 75 to 84 decibels, the probability that the noise had caused hearing loss is .33, and the corresponding probability for those exposed to 85 to 90 decibels is .61.

83 pages. $1.04. Mic 56-1778

HISTORY

HISTORY, GENERAL

THE ROLE OF UNITED STATES SPECIAL AGENTS IN THE DEVELOPMENT OF A SPANISH AMERICAN POLICY, 1810-1822

(Publication No. 13,769)

John Crane Pine, Ph.D.
University of Colorado, 1955

Supervisor: Professor Fritz L. Hoffmann

The government of the United States from 1810 to 1822 faced the difficult problem of establishing an official policy to be followed in its relations with the rebellious Spanish American colonies. Should the United States government officially recognize the colonies, or should it maintain a policy of nonrecognition and impartial neutrality? It was during this period that the government of the United States sent a number of special agents to Spanish America. These agents were to explain the United States' policy of recognition and neutrality to the Spanish American patriots. The information submitted to the state department by the special agents was used by Presidents Madison and Monroe in the formulation of a Spanish American policy.

In 1810, when it seemed likely that independent states might be created in Spanish America, President Madison dispatched special agents. They were to evince signs of sympathy for the patriot cause and to collect information on the progress of the revolutions. At the same time, Madison established a policy of strict neutrality toward the colonies. Patriot governments requested recognition and assistance from the United States. Madison's successor, Monroe, however, tightened neutrality legislation. Monroe, also, dispatched special agents to South America. Recognition was not granted to the new states, for Secretary of State Adams believed they were not de facto. A policy of caution was the watchword.

Those dispatched from 1810 to 1816 constitute the first wave of agents. They were sent to both patriot and royalist governments. William Shaler, the first agent to Spanish America, was sent to Cuba. He reported that there was a noticeable lack of liberal elements on the island and that the Spanish would remain in control. Two agents were sent to the patriot state of Venezuela, Robert K. Lowry in the commercial sphere, and Alexander Scott for political affairs. These agents reported the collapse of the patriot government and the resumption of Spanish control. In 1815, Christopher Hughes arrived on the same scene to converse with the Spanish colonial government on the return of American seamen and the lifting of a naval blockade.

Southern South America was likewise covered by special agents—Joel R. Poinsett, consul-general to Buenos Aires and Chile; Thomas Halsey, consul, and William Miller, vice-consul, for Buenos Aires. Poinsett's lengthy reports to the state department traced the development of Spanish American institutions and provided information on the revolution in Buenos Aires and Chile as well.

In 1817 Monroe, realizing that patriot victories demanded consideration, dispatched a second wave of agents. The most publicized of these were those of the Monroe Commission, C. A. Rodney, John Graham, and Theodorick Bland. Unable to come to a unified conclusion concerning conditions in the United Provinces of Río de la Plata, the commissioners wrote individual reports. Special agents William G. D. Worthington and John B. Prevost were assigned to Buenos Aires, Chile, and Peru. Their voluminous reports revealed valuable information on the political, commercial, and military state of affairs. Two other agents, Baptis Irvine and Commodore Oliver H. Perry, were dispatched to Venezuela. Their reports led to a better understanding of many commercial difficulties which had grown out of the revolution.

During the twelve years that the United States withheld recognition, its policy of caution was due in part to the reports of special agents. Conversely the decision to recognize the insurgent governments was also based upon the communiques of the special agents who had served in South America. 570 pages. $7.13. Mic 56-1779

RECORDING AMERICA'S PAST: AMERICAN HISTORICAL WRITING, 1607-1889

(Publication No. 16,219)

David Dirck Van Tassel, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Merle E. Curti

The causes which American histories have supported in the time in which they were written is one key to the understanding of the development of historical writing in America. A second key to the growth of historical studies in America is the division and interaction between national historians, those who view past events with an eye to explaining the history of the nation, and local historians, those who consider events solely in terms of history of their locale.

The first histories of each colony were the travel accounts of explorers in which narrative was subordinated to description of geography and Indian population. Then followed accounts written by colonists themselves, emphasizing the natural attractions of their particular area and their conquest of geography and Indians, with the purpose of attracting new settlers. As the colonies grew older historical writing was inspired by other problems and supported colonial rights and their primacy in the British Empire.

The Revolution gave rise to national historical writing in America. Histories of the Revolution served to demonstrate that the new country had a common heritage and gave to the world the revolutionist's interpretation of the causes and meaning of the war for Independence.

After Independence local historians defended the primacy of their state or localities in the record of the new nation. Local historians founded historical societies, dedicated to the searching out and publishing of manuscripts relating their state's history. In the 1820s historical societies intensified their search for new sources and began a movement to investigate foreign archives for fresh material.

National historical writing was slow to mature. After the first burst of books about the Revolution most history of national events took the form of biography either collections of biographies of men from various areas of the country or biographies of national figures such as Washington or Franklin. Thomas Jefferson during and after his presidency made many attempts to capture the nation's past for the Republican party, but for the most part his efforts failed. Meanwhile New Englanders were beginning to write the nation's history in the form of textbooks which spread over the country in the wake of the public education movement.

As the sectional struggle grew more and more heated histories of the nation championed the cause of one section of the country or the other or they avoided controversial topics and emphasized foreign wars. The Civil War brought about a complete breakdown of national history writing.

Meanwhile in the decade before the Civil War there developed a new breed of local historians--the critical historians. These men were dedicated to the history of their locality but also they were dedicated to discovering the truth of history, not to teaching moral lessons.

The Civil War put a stop to most local historical activity, but it inspired the writing of a new kind of local history--the regimental history. The Civil War also introduced journalists as historical writers.

In the 1870s there arose a new group of trained historians who made history an academic profession. With the rise of the professional historians, the local critical historians had little choice but to play the subordinate role of handmaid to the new group whose methods were critical and even "scientific," whose subjects were local, and whose spirit was national. Further chapters in the history center around the professional historians, who, having obtained dominance in the field, set about securing their position.

358 pages. $4.48. Mic 56-1780

HISTORY, MEDIEVAL

A CRITICAL EDITION OF ROBERT GROSSETESTE'S COMMENTARIUS IN OCTO LIBROS PHYSICORUM ARISTOTELIS

(Publication No. 13,761)

Richard Clark Dales, Ph.D.
University of Colorado, 1955

Supervisor: Professor S. Harrison Thomson

Robert Grosseteste (1168?-1253), profiting from the developments in logic of the twelfth century and applying them to the world of physical experience, developed techniques of induction, of experimental verification and falsification in a series of works, written between 1209 and 1235, which laid the groundwork for modern scientific procedure. Conceiving the world to have been created by the extension of simple matter into three dimensions by an infinite multiplication of light ("the first corporeal form"), Grosseteste felt that physical phenomena could best be studied by investigating the behavior of light, the cause of all physical motion. Since the propagation of light followed fixed mathematical laws, Grosseteste was led to emphasize the use of mathematics in describing physical occurrences.

In the course of his investigations, Grosseteste discussed in a strikingly original manner many questions of basic importance to modern scientific theory. One of the most important works of this type is his Commentarius in Octo Libros Physicorum Aristotelis. In this work he elaborates and refines Aristotle's method of induction, eliminates "chance" and "luck" as legitimate objects of scientific inquiry, and denies that mathematical entities have any objective existence apart from the physical bodies in which they inhere; he claims that they exist only in the imaginations of mathematicians, who abstract them from real beings. He also shows the element of error and uncertainty inherent in all empirical sciences to be attributable to the arbitrary units of measure which men must employ. He discusses the nature of a continuum and its divisibility, and of infinity. He denies the possibility of the existence of a vacuum, and emphatically denies the eternity of the world.

Grosseteste's Commentarius in Octo Libros Physicorum Aristotelis exists in three manuscripts: Oxford, Digby 220; Oxford, Merton 295; and Venice, San Marco, 222. The Digby MS., the best of the three, was written in England about 1425 from several other MSS. It represents a tradition different from that exemplified by the other two MSS., each of which was written ca. 1325, although there is not sufficient evidence available to construct a stemma. The present edition does not give a complete collation of the three MSS., such things as close synonymns, inverted word order, etc., being ignored. The spelling of the codices is preserved in this edition, or, when it is incorrect for the thirteenth century, corrected without note.

The Commentary on the Physics was probably written over a period of years, ranging from 1228 or 1229 through 1231 or 1232. It is not a finished and polished work by any means, but on the other hand it is a more ambitious and highly organized undertaking than the term "marginal glosses" (employed by D. A. Callus and A. C. Crombie) would imply. As we have the work today, it is probably a final draft of a genuine commentary which Grosseteste left unfinished because of the press of his ecclesiastical duties (he became Bishop of Lincoln in 1235). Little mention is made of other authors in the Commentary. Aside from the authors mentioned by Aristotle himself, Grosseteste refers only to Plato among the ancients, Augustine and Boethius among the Fathers, Avicenna, Averroes and Alfarabi of the Arabs, and Richard of St. Victor of the modern authors. He also refers to his own works Commentarius in Libros Posteriorum Analyticorum Aristotelis, De Luce, and De Motu Corporali et Luce.

316 pages. $3.95. Mic 56-1781

HISTORY, MODERN

GARRISON LIFE AT FRONTIER MILITARY POSTS, 1830-1860

(Publication No. 16,758)

Richard Dalzell Gamble, Ph.D.
The University of Oklahoma, 1956

Daily life at most frontier military posts reflected a well organized, though isolated, social community. Between 1830 and 1860 about fifty army posts were established in the trans-Mississippi West to house infantry and mounted units whose basic mission was to facilitate the forward progress of westward expansion. In a military milieu, life's essentials were embellished by a variety of activities.

Frontier military personnel represented diverse backgrounds. The officers were usually West Point graduates and reflected standards of middle and upper income groups. Enlisted men were usually recruited from a group which included unemployed laborers, displaced farmers, and immigrants. The standing army was small in theory and actuality, for the burden of patroling and infinite frontier was added to the expected low pay, endless work, and strict discipline.

Western garrison sites were determined by timber, water, and soil resources sufficient for the support of about two hundred men. For defense purposes the average post was constructed in rectangular form, but ultimately it was expanded beyond the stockade limits. Both civilian and military personnel engaged in the construction and maintenance of frontier posts so that something of a hybrid community was developed. Basic food items were furnished by the Quartermaster Department, yet military policy dictated a high degree of self-sufficiency, especially in raising vegetables and keeping livestock.

The frontier soldier found diversions in hunting, fishing, shooting matches, and in watching Indian ceremonials and ball games. His evenings were consumed by card playing, drinking, and story telling. Several posts had billiard tables and many supported libraries. Amateur theatricals, musicals, and dances displayed a variety of talent among military personnel.

Frontier military men succeeded in acquiring chaplains' services at twenty posts in 1838 and at ten others after the Mexican War. Chaplains aided in reducing drunkenness and desertion at many posts through regular church services, Bible classes, and temperance societies. The chaplains also instructed soldiers' children in the three R's, which frequently were the extent of formal education for most children and soldiers alike.

The army's medical units in promoting an effective public health program raised the efficiency of frontier commands. Almost every post boasted the services of an accredited physician who was often overworked, but nonetheless available. In addition to treating illnesses and broken limbs, the post surgeon offered medical advice in respect to diet, shelter, and environment.

In the final analysis, the average frontier post became a self-sufficient community, primarily in respect to supplies of food, water, fuel, and building materials and in a secondary sense in respect to medical, moral, and morale services. Frontier posts were isolated, but not inaccessible. Mail service was sporadic, yet available. Visitors were rare, but always welcome.

361 pages. $4.51. Mic 56-1782

HOME ECONOMICS

AN ANALYSIS OF THE SILK INDUSTRY (PARTS I-V)

(Publication No. 13,963)

Rose Padgett, Ph.D.
Purdue University, 1955

Major Professor: M. M. Erselcuk

Despite considerable opinion to the contrary, silk continues to dominate in luxury items in apparel and even in men's wear. Both the inherent qualities and the prestige of silk have always placed it in an advantageous position for use in fiber blends. Silk lifts the lower priced man-made fibers into a more desirable, higher priced apparel group, and at the same time silk blends are placed within the reach of the lower income groups. The global promotion of silk, along with the steady increase in population and higher standards of living in both the developed and newly developed countries, provides added potential silk consumers in a world where demand for silk is high and where silk stocks are low. The use of fiber blends, both natural and man-made, does much to satisfy this increasing consumer demand for the luxury of silk.

Innovations in all phases of sericulture techniques are now resulting in even better quality and wider variety of silk fibers and fabrics. The call for domestic silk on the home market in the major sericultural areas of the world has markedly reduced the flow of raw silk in international trade. The global use of wild silks and native fabricated silks and silk blends has increased similarly in post war years. Increased use of wild silk cocoons, at present going to waste, may well materialize as the result of innovations in the gathering and processing of these cocoons.

Statistics indicate that surplus labor on the home market may be used to fabricate desired native silks for the world market, and undeveloped countries such as those in the East Indies might do well to pattern their new textile industries after the Japanese sericulture design, not only in improved mulberry cultivation, seed collective hatching, feeding, and cocoon sales, but also in mechanical reeling, testing techniques, weaving, finishing, marketing and silk promotion. Above all, raw silk imports from nearby countries should be used for weaving.

World raw silk production figures for 1953 show Japan as prime producer with 15,043.3 metric tons, China second with 4,200.0 metric tons, Russia third with 1,900.0 metric tons, Italy fourth with 1,478.5 metric tons, and India fifth with 843.0 metric tons. Current percentage share of the various regions of the world total for the year 1953 runs as follows: Far East, first with 78.4 per cent; followed by Free Europe and Turkey, second with 8.1 per cent; and Russia and European Satellites a close third with 7.9 per cent of the world raw silk production. World production of silk is about one per cent of the world's soft fiber production.

Since Japan's silk contribution accounts for 60 per cent of the world output, the present day success of world sericulture is largely attributed to the development of sericulture in Japan. Governments are working hard to foster sericulture in their own countries patterned after the Japanese 5-year plan. The increased yields and new technology in the silk reeling section tends to account for most of the silk expansion achieved during the last five years.

It appears that man-made fibers will be used in several of silk's former uses, but it seems probable that silk will hold its place in the world market for textiles of the highest quality. 391 pages. $4.89. Mic 56-1783

JOURNALISM

THE FOREIGN CORRESPONDENTS: A SOCIAL AND FUNCTIONAL ANALYSIS

(Publication No. 16,124)

John William Maxwell, Ph.D.
State University of Iowa, 1956

Chairman: Professor Leslie G. Moeller

An exploratory study of the newsmen who are employed abroad by American commercial news organizations—the foreign correspondents—was carried out within the framework of the five major institutions: familial, educational, economic, political, and religious. More specifically, an attempt was made to discover what kinds of families they came from and what kinds of family life they now have; the extent of their education, both formal and informal; their manner of earning a living and the product thereof; and their political and religious preferences.

The universe included full-time correspondents, both American and foreign nationals, of radio (including television) and news magazines, as well as those of newspapers and agencies (the Associated Press, etc.). Data were gathered primarily by means of a questionnaire airmailed to most parts of the world. Among the 209 respondents were representatives of all the major American foreign-news organizations: The Associated Press, The United Press, International News Service, The New York

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

Times, Time magazine, Columbia Broadcasting System, the National Broadcasting Company, and so on. As closely as can be determined, the Americans among the respondents equaled 55 to 60 percent of all full-time American correspondents abroad at the time of the survey.

Some of the findings which may be of most general interest are the following:

Nearly one-third of the American correspondents had at least one foreign born parent, a rate which is nearly twice that of the general United States population. When foreign nationals are included, more than two-fifths of the respondents had foreign parentage.

Nearly two-thirds of the respondents came from business or professional families. Not a single respondent reported farming as the principal occupation of his father.

A third of the correspondents were products of the Northeast United States and well over one-quarter, of the Midwest. The South and West combined produced less than one-fifth of the respondents.

"Big City" is an appellation that might well apply to the respondents. Nearly one-third grew up in cities of a million or more population, and well over half in cities of one hundred thousand and up. Two-thirds were from cities of twenty-five thousand or larger.

Foreign correspondence as a way of earning a living seems to retard the development of family life among its practitioners. Nearly one-fifth of the 209 correspondents were not married; one-quarter of the 128 married correspondents had no children. Three-fifths of the married respondents did not have their first child until they were thirty-one years of age or older.

It is a commonly held view that a majority of the foreign correspondents marry foreign women. But among the Americans in the present study who had ever been married less than one-quarter married foreign women.

Among the 209 correspondents, 61.2 percent were college degree holders. When non-graduate college men among the respondents are added to the graduates, the total for the two groups equals 90 percent of the 209. More than one-tenth of the correspondents had earned master's degrees and two were Ph.D.'s. Of the 127 who received college degrees, 40 percent graduated "with honors." Included in this group are thirteen (10 percent of the graduates) who were elected to Phi Beta Kappa.

The increasing importance of the school of journalism in preparing students for news jobs is seen in the fact that one-quarter of the correspondents who attended college majored in journalism—more than concentrated on any other subject. In 1938 Rosten found that only a tenth of the Washington correspondents he investigated had specialized in journalism.

Before becoming foreign correspondents, a third of the respondents could speak one foreign language, a tenth could speak two, and about one-twelfth could speak three or more. However, just under half of the newsmen received their first foreign assignments before they could speak any language other than English. Despite the fact that nine-tenths of the respondents thought it was "very" or "fairly" important for a correspondent to be able to speak the language of his assigned country nearly one-quarter of the correspondents spoke no language other than English.

That foreign news assignments are given primarily to young men can be seen from the fact that more than 80 percent of the respondents received their first post abroad before they were thirty-five. One-quarter entered foreign correspondence between the ages of twenty-three and twenty-six, and nearly a third between twenty-seven and thirty.

Despite some news executives' statements to the contrary, it would appear that one effective way to enter foreign correspondence is to go to or be in a foreign country —to be immediately available when openings occur. Nearly one-quarter of the Americans in the present study got their first foreign jobs by being abroad.

Figures submitted by the respondents indicate that a long work week is not unusual for a foreign reporter. A tenth said they worked seventy-one or more hours a week. Nearly three-tenths said they worked fifty-six to seventy hours weekly, and another three-tenths, forty-six to fifty-five. Less than one-quarter put their estimates below forty-six hours a week.

There is a prevalent notion that foreign correspondents spend a considerable amount of time traveling. The present figures support this idea. Whereas only 6 percent said they did not travel at all on work-connected trips, 86 percent said they traveled from one to more than thirty-three weeks annually. More than half traveled from five to twenty weeks a year. About 15 percent were traveling more than twenty weeks annually.

Among the abilities required for foreign correspondence, writing is probably one of the most important. There was no respondent among the present group who estimated his weekly output of writing at less than 1,000 words, and one agency writer calculated his total at 30,000 words a week. A fifth of the group wrote between 1,000 and 2,999 words weekly, another fifth, between 3,000 and 3,999. About one-quarter averaged 4,000 to 5,999 words a week, and another quarter 6,000 or more words weekly.

In general, the foreign correspondents' incomes from news work compared favorably with the incomes of professional people in the United States. Whereas United States income figures for 1951 show that the average net income, before taxes, of doctors was $13,432; of lawyers, $8,732; and of dentists, $7,820, the foreign correspondents had average annual earnings from news work of $9,300. The median income was approximately $10,000. Three respondents reported annual incomes of less than $2,000, and five, incomes of $20,000 or more. The highest was in excess of $30,000. Sixty-two correspondents reported incomes from sources outside of their regular news work; lecturing, article writing, television appearances, and so on, provided earnings ranging from "insignificant" to $15,000 annually.

Among the 209 respondents in the study, 192 (91.9 percent) said they would enter foreign correspondence again, if they had the choice to make over. Only three (1.4 percent) indicated that they would not become foreign correspondents; four were uncertain, and ten did not answer the question. 500 pages. $6.25. Mic 56-1784

LANGUAGE AND LITERATURE, GENERAL

INDIA IN ENGLISH FICTION 1770-1860

(Publication No. 16,146)

Irene Bostrom, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Paul L. Wiley

The English connection with India resulted in a large number of novels, most of them now forgotten. This dissertation is a study of all the fiction of this type between 1770 and 1860. Its purpose is to show the relationship of these works to the history of English rule and to consider their place in the development of fiction. The novels indicate the extent of interest in India and show what the prevailing concept of the East was in each period. They give insights into the life and work of the English administrators and also reflect the attitudes at home. While most of them belong in the field of the lesser novel--in sub-literature rather than in the main stream of development--they helped to add vigor to fiction and to widen its horizons.

In the last decades of the eighteenth century there was intense curiosity about India. The nabob or wealthy returned Anglo-Indian became a stock figure and his treatment in the minor novels reflects the changes in public feeling. Although only two novels of this period seem based on actual experience, condemnations of nabobs and defenses of their conduct appeared frequently. India became useful as a plot device for sentimental writers and afforded new thrills for sensational ones. It gave thesis novelists a chance to use unconventional settings and characters and to add interest to their doctrines. Even the Gothic novelists, under the influence of romantic paintings, made use of the Indian scene. The old concept of the East as the source of wisdom which had characterized the Oriental apologues gave way to a stress on its fabulous wealth.

This view was succeeded for a short time by an attitude toward India which emphasized its beauty and ancient culture. Although Moore's Lalla Rookh and the Moghul architecture of the Pavilion at Brighton are the chief results of this enthusiasm, it is reflected in fiction as well. In the 1820's the favorable view gave place to portrayals of the East as a land of heathen abominations. More information about the seamy side of native life became available and missionary groups spread news of Hindoo evils. Philip Meadows Taylor's realistic Confessions of a Thug (1837), which was immensely popular, helped to strengthen this view. Although several novels about native life appeared which were based on experience, the period also saw the publication of numerous poor imitations of Scott romances. Thackeray's The Tremendous Adventures of Major Gahagan is a burlesque of such works. The life of the English in India was presented in satires and novels of manners. These were nearly all marked by "Anglo-Indian melancholy" and emphasized the difficulties of life in the East and the low state of army morale. Englishmen who had returned home were portrayed as comic "yellow nabobs" until Thackeray came to their defense.

Philip Meadows Taylor, "the Scott of India," was an able administrator who knew all phases of native life. All but two of his novels appeared after the Mutiny, but he himself belongs to the earlier age. Although his novels were not great enough to earn a permanent place in literature, he was the best informed and most influential Anglo-Indian writer of the century.

The Sepoy Mutiny of 1857 resulted in a brief revulsion of feeling against the Indians and a flood of novels extending through several decades. By the 1870's, however, the rise of imperialist sentiment brought a new enthusiasm and the appearance of some of the best works in this field. Thus the way was prepared for Kipling, the first writer to bring fiction about India out of the field of the "particularist" novel and into a major place in English literature.

525 pages. $6.56. Mic 56-1785

THE PRINCIPLES INVOLVED IN THE CONSTRUCTION OF A BOOKLIST FOR SENIOR HIGH SCHOOL STUDENTS

(Publication No. 16,592)

Wallace Leo Goldstein, Ph.D.
New York University, 1956

The purpose of this study was to discover the pertinent factors, techniques, criteria, and principles significant in the construction of a booklist for senior high school students.

The Problem

A booklist has long been considered a necessary tool for the teacher of English in providing reading guidance for high school students. However, many teachers of English expressed dissatisfaction with the reading lists on hand. Weaknesses were found in the kinds of books appearing on the lists, the methods of selection of titles, and in the provisions for the individual reading needs of the students. Furthermore, standardized booklists did not provide specifically for the actual needs existing in the various schools. Therefore, in order to determine what principles should be recognized in booklist construction, this investigation was conducted.

Procedure

To discover fundamental techniques employed in the construction of booklists, the methods of development and the objectives of published, standardized lists were examined. In order to learn the methods of booklist construction used in various senior high schools, a questionnaire was sent to the heads of English departments in

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selected high schools throughout New England. Prevalent techniques employed in the development of booklists by these schools were thus secured.

Essential factors other than methods employed in developing actual booklists were obtained in the same questionnaire. In addition, those factors considered to be significant as a result of actual reading investigations conducted were recorded.

A list of specific principles was then compiled based on the information gathered. The total number of twenty-four principles was validated by a group of ten judges consisting of librarians, teachers of English, and authorities in the field of reading.

As a final validation, a booklist based entirely on the principles derived from the study was constructed, and used for one year at the J. M. Wright Technical School, Stamford, Connecticut.

Findings

The group of judges rated the principles as at least advisable in the construction of a booklist. Twenty of the principles were considered to be essential by the majority of the judges. A booklist based on the twenty-four principles was used at the J. M. Wright Technical School from November, 1954 to May, 1955. The following results were secured:

1. There was an increase in the number of books read and books borrowed from the school library.
2. The average reading grade of the students increased .18, a significant increase, from September, 1954 to May, 1955.
3. Comments of instructors and students concerning the use of the list were generally favorable.
4. Certain changes were recorded in the expansion of student reading interests and upgrading of student reading materials.
5. Students still retained, however, an interest in reading literature generally considered to be objectionable.

Results

The results of the study justify the following conclusions:

1. The response of teachers of English indicated that there is an interest in using a booklist in the senior high school reading program.
2. The judgments of the jury indicate that the principles are worthy of application.
3. A booklist constructed as a result of the application of the twenty-four principles and properly utilized seems to help to increase the general reading activity and interest of the students.
4. A good booklist based on scientific procedure is serviceable to the teachers of science and social studies as well as the teachers of English and the librarian.
5. The use of a booklist, scientifically prepared, does not necessarily eliminate the students' desires to read literature of questionable literary merit.

238 pages. $2.98. Mic 56-1786

LÜ TUNG-PIN IN THE YÜAN DRAMA

(Publication No. 16,543)

Richard Fu-sen Yang, Ph.D.
University of Washington, 1956

Lü Tung-pin, an important figure in Taoism with rich legendary records, has been frequently written about by the authors of tsa-chü or drama of Yüan time. These plays are usually classified together with a number of other Taoist plays as the first group of the drama of Yüan with the title of "Immortals and Taoist Transformations".

In this study an effort has been made to establish a record of the life of Lü Tung-pin. There is disagreement on the date of Lü's birth. The chief difficulty lies in the fact that very few historical data on Lü exist in the official documents. Even though the Taoist record of Lü is mostly legendary, its date of Lü's birth is supported by the dates of his family members in the official history.

The role of Lü Tung-pin in the Yüan drama is then analyzed and the plots presented by the dramatists are compared. His supernatural power of transforming others, men and tree-spirits, into immortality is the keynote to his dramatic role. However, other important aspects of Lü's life, such as his own conversion to Taoism, his thoughts and his poetry as found elsewhere, are also examined and compared. Although minor details are presented in the plays of Yüan, the mysterious and immortal nature of Lü Tung-pin is uniformly treated by all the playwrights of Yüan time.

The third point of Lü Tung-pin in the Yüan drama is his association with a legendary group of figures, the so-called "Eight Immortals" or the pa-hsien. The term "pa-hsien" is mentioned before, in the literature of the pre-Yüan period, but the identification of these figures is made for the first time in the Yüan era. Just as with many other legends, the legend of the pa-hsien is also first introduced and originated in the drama of Yüan. But the final formation of these eight figures is not established until the Ming dynasty.

The last chapter deals with the relationship of the rise of the Taoist religion and Lü Tung-pin's role as a patriarch of Taoist sects in the early Yüan period to the development of drama or tsa-chü as a new genre in literature in this period. Both Taoism and drama have a great deal to do with the social background of the Yüan society particularly with the policy of social discrimination against Chinese in general and scholars in particular. The scholarly class to which all the playwrights belonged became frustrated in its ambitions of getting into official life because of the discriminatory policies in the examinations, and in the employment at the Yüan court. So they devoted their efforts to creating a new type of literature in which they freely expressed their opinions and feelings. They were, at the same time, frustrated because of ill-treatment and their low social status in Yüan society; so some of them turned to the Taoist religion, in which they found a new haven of freedom and better treatment, and they praised the ways of Taoism in their plays. In both these aspects, Lü Tung-pin became a dominant figure.

303 pages. $3.79. Mic 56-1787

LANGUAGE AND LITERATURE, LINGUISTICS

ESTUDIO LEXICOGRÁFICO DE EL PERIQUILLO SARNIENTO

(Publication No. 16,579)

Jack Emory Davis, Ph.D.
Tulane University, 1956

The need for a thorough study of the language of Fernández de Lizardi's El Periquillo Sarniento has long been apparent. The primary purpose of this dissertation is to catalogue and define all the novel's words, idioms and phrases of lexicographical interest not listed in the seventeenth edition (1947) of the Diccionario de la lengua española (Academia Española). The result is a glossary of over five hundred items, most of which are Mexicanisms or Americanisms in the category of semantic variations. Another group comprises words or expressions deriving from the Nahuatl; for these etymologies have been included. The dissertation also contains three appendices listing (1) proper names and allusions which seem to require clarification or discussion, (2) proverbs and folk expressions, and (3) phonological and orthographic variations from standard Spanish. Syntax and morphology are treated briefly in the Introduction. In the Vocabulary, page references for the quotations from the novel refer to the two-volume edition of El Periquillo Sarniento issued by the Casa Editorial Stylo in 1942.

In the preparation of this study all the major editions of the novel, from the first of 1816 to the one edited by Jefferson R. Spell in 1949, have been employed. For the purposes of linguistic analysis, the most important of these are undoubtedly the 1816 edition and the fourth of 1842. In the 1816 edition Lizardi included a number of explanatory footnotes, some of which offer definitions of terms used in the text. Many of these footnotes and some additional ones are found in the third edition of 1830-1831 and in all the subsequent editions. The 1830 printing also includes a brief glossary consisting mostly of Aztecisms, and this glossary or one similar to it is furnished in several later editions. But there has been no consistency or pattern in the reprinting of glossaries and footnotes, and in any event this material furnishes lexicographical aid for only a few of the many obscure terms and allusions which the novel contains. The fourth edition of 1842 incorporates the only revision of the novel's text made since 1816 and serves as a model for all subsequent editions.

In the Vocabulary a full documentation of each item is attempted. This includes citations of parallel usage taken largely from nineteenth century Mexican literature. As could be expected, the other writings of Fernández de Lizardi and the works of costumbrista authors such as Manuel Payno, Luis G. Inclán, Guillermo Prieto and José T. de Cuellar ("Facundo") were found to be particularly rich sources of collateral material. But works from other literary periods and areas, especially those of Spain's Golden Age and Mexico's contemporary literature, frequently supply chronological data and information about geographical distribution. The documentation also makes every effort to be as nearly complete as possible in the matter of lexicographical references, as well as in pertinent commentary pointing up comparable or related problems suggested by Fernández de Lizardi's vocabulary.

The methodical analysis of the language of El Periquillo Sarniento gives ample proof that the author possessed a narrative style of great range and vigor as well as an extraordinary ability to reproduce the speech of his people and his time. Furthermore, as a result of the material presented in this dissertation, a satisfactory annotated edition of Fernández de Lizardi's picaresque masterpiece should now be possible.

296 pages. $3.70. Mic 56-1788

LANGUAGE AND LITERATURE, MODERN

SCHILLER'S IDEOLOGICAL APPROACH TO TRAGEDY

(Publication No. 16,623)

Donald Edward Allison, Ph.D.
Washington University, 1956

Chairman: Fred O. Nolte

Schiller came to the early awareness that he had been born into an age and environment that were culturally impoverished. In view of his own aspirations, the problem of self-realization in such a prosaic era was of immediate personal concern to him, and its larger implications for his generation preoccupied him no less. The adverse situation of his contemporaries is evident in much of Schiller's writing, especially in his efforts to analyze and overcome this crisis. He concludes that civilization has deprived modern man of his integrity of being, and the alternative which he advocates to this spiritual depletion is an "idealism" that can be studied particularly in his philosophical and aesthetic treatises and in his dramas.

While the earlier of Schiller's two major essays, the Briefe über die ästhetische Erziehung des Menschen, is an examination of the status of civilization and mankind in general, the second, über naive und sentimentalische Dichtung, has been selected for more extended consideration in this dissertation since it represents the more personal aspects of his concern as well as the more comprehensive conclusions of the former. Moreover, in the closing pages of this essay, Schiller translates his theory of sentimental poetry into the "idealism" which he regards as the means by which man is to regain spiritual integrity. A further transition in the same treatise—from the theory of "idealism" to the idealist as such—indicates the importance of studying Schiller's drama—particularly those written after he had formulated his theory—in conjunction with his essays; in a very definite sense, the drama becomes the proving ground of his theory. With respect to his major preoccupation, his dramas are remarkably uniform in that they display little variation of the thesis first developed in Die Räuber; his heroes and heroines are betrayed or corrupted by a degenerate civilization into crime, sin, or punishment. Max Piccolomini and Johanna have been chosen as typical representatives of Schiller's practical demonstration because he has given to them heroic stature and because, in spite of his avowed intention of seeking a balance between idealism and realism, these two,

in their idealism, stand in complete contrast to the world in which they live, thus fulfilling an essential condition of Schiller's hypothesis.

As a substitute for the integrity lost to himself and to his contemporaries, Schiller offers a "higher integrity." With regard to the poet, as is apparent in Schiller's theory of poetry, this "ideal wholeness" is not a oneness with art, and it is not vitally experienced. Rather, it is speculatively contrived, opposed to life, and self-determined. Similarly, self-assertion is a dominant trait of the idealist. This is confirmed, for example, by Max Piccolomini's resolute determination to recognize no attachment as binding, to assert his moral integrity, and his belief that only through a display of will can he prove himself. And the same attitude characterizes Johanna. She is redeemed only when will triumphs over inclination.

That Schiller sensed the insufficiency of his solution is suggested by his own admission. In 1795, he confessed to Goethe that philosophy was austere, inflexible, abstract, unnatural and that the philosopher was only a caricature of the true man. But, while Schiller deplores the disparity between life and speculative philosophy, this, nevertheless, remains the substance of the solution he advances.

215 pages. $2.69. Mic 56-1789

MIDDLEMARCH FROM NOTEBOOK TO NOVEL: A STUDY OF GEORGE ELIOT'S CREATIVE METHOD

(Publication No. 16,382)

Jerome Beaty, Ph.D.
University of Illinois, 1956

Chapter 1 presents a detailed chronological account of the writing of Middlemarch, 1869-1872.

The first half of Chapter 2 shows how freely George Eliot used medical and historical notes from her "Quarry." A note rarely appears verbatim in the novel; many do not appear at all. Some historical details, even dates, in Middlemarch are not even taken from the notebook. George Eliot's familiarity with the period 1829-1832 and her use of several technical devices—separating mention of day, month, and year; separating historical event and indication of date; omitting from the foreground direct mention of the major political events—permitted her to use historical detail to lend depth to the fictional action without that detail becoming obtrusive. The second half of the chapter unravels the complex and accurate chronology of the novel.

Chapter 3, based on study of the paper, ink, handwriting, pagination, and revisions in the British Museum manuscript of Middlemarch, reconstructs George Eliot's fusion of the beginning of a separate story, "Miss Brooke," with the beginning of the almost abandoned Middlemarch. Without rewriting George Eliot used the opening nine-plus chapters of "Miss Brooke" as the opening of the new Middlemarch. She then revised, recast, rewrote, and added to the opening few chapters of the original Middlemarch and used the new version as Chapters 11-17 of the present novel. The origin of each page within these chapters is identified.

Chapter 4 tells the history of the half-volume, bi-monthly parts publication of Middlemarch, a format suggested by George Henry Lewes and dictated by the lethargic fiction market and the form and length the new novel was taking. The eventual financial success of Middlemarch, however, came not primarily from parts sales but, unexpectedly, from sales in the cheap editions; and the originally intended alternating of "Miss Brooke" and "Middlemarch" parts bi-monthly publication made impossible, George Eliot having to include all strands of the plot in each part, being forced, in effect, to unify the novel more completely. The one other significant change directly traceable to parts publication is the transposition of several blocks of chapters in Parts II and III.

Chapter 5 traces George Eliot's plans, chiefly for the last five parts of Middlemarch, through the notebook and into the novel. She had most of the main events planned in advance. When she finished a part, she blocked out the major action of what there was left, noted the background of the situation and the motives of the characters involved, arranged the actions into scenes or chapters and grouped the chapters into half-volume parts, rearranged sequences—continually discovering new relationships among characters and events—and finally began to write, inventing as she did still newer incidents and links.

Chapter 6 reveals that—contrary to her own, commonly accepted description of writing her best work as if inspired, "without blur or erasure"—to George Eliot writing was truly a process: she constantly revised, while she was writing, after reading passages over, in proof. Authors are indeed inspired and do create without ratiocination; but the results of inspiration are frequently submitted to the trained judgment of the author and its results are subject to revision. 363 pages. $4.54. Mic 56-1790

LE SCEPTICISME DE VALERY

(Publication No. 16,274)

Hanna Kurz Charney, Ph.D.
Columbia University, 1956

This study represents an attempt to trace the curve of Valéry's scepticism seen as a coherent line of thought which resolves the apparent contradictions in the author's work. Valéry's main views seem to be encompassed by a dialectic pattern: they thus fall into three movements explaining and completing one another.

In the first movement we find Valéry's panoramic criticism of the world: we see his attacks on institutions, prejudices, conventional values—all in terms of a relativism close to that of Montaigne, the thinkers of the XVIIIth century and all traditional sceptics. The second phase is the reaction of a rationalistic mind building a grandiose Utopia in spite of the nihilistic results of all analyses. But a complex of thoughts resulting from these two positions indicates a final and all-absorbing scepticism.

Thus, we first present Valéry's annihilating ideas on society, morality, religion, philosophy, science, and finally on the individual, the ego. Valéry turns against literature itself, and from a position strikingly similar to that of the "impressionnistes" when they undermine the foundations of dogmatic criticism, asserts the impossibility of all communication through art, shows the futility of all canons of criticism and the relativity of literary standards.

This destructive work has a strong counterbalance. On the Cartesian model, Valéry constructs a world of the mind on the sole basis of one irreducible psychological phenomenon: consciousness. On a strictly dualistic foundation, he eliminates all emotions, all intermediary regions between body and mind. The angel and the beast coexist peacefully, and men (Monsieur Teste, for instance) remakes himself in the image of his reason. This mathematically abstract thought is cast into a system akin to music, in which words and ideas play a purely functional role, transcending their meanings by their relationships. Art is the ideal medium. Emulating music and architecture, poetry can strive towards complete formalism, and thus resist time and the change of tastes in its self-sufficient beauty. It must be "pure"—analytically as well as synthetically—and thus it creates a realm where the public can join the author in the enjoyment of esthetic truths.

But this ideal order is constantly threatened by nature: life, in its compelling dynamism, interrupts consciousness by a flux of chaotic realities. Through many sudden events, it forces upon us its own irrationality, its own confusion of mind and matter always impeding on each other. The artist, like all men, is a victim of chaos and can never achieve perfection. These vital doubts reach out to the very roots of productivity; and, indeed, Valéry's books are mainly fragments and his poetic inspiration, however beautiful, seems short of breath. True literature is unable to express the changeability and unending variability of the individual: silence is the logical conclusion. On the other hand, fame throws its nets—and the artist is caught in the temptation to produce, losing himself and his higher endeavors in the "vile multitude." A base compromise is at the heart of all literature.

However, the isolated points of consciousness and of art retain their esthetic purity. And there is, in Valéry's thought, a thematic interplay of ideas, an autonomous activity reflecting the life of one of the most alert and vigorous minds of our century; a mind engaged in an unrelenting but always lucid quest, never stopping at any comforting illusions: not even those it made for itself.

194 pages. $2.43. Mic 56-1791

A CRITICAL HISTORY OF THE PRE-ELIZABETHAN ENGLISH SONNET

(Publication No. 16,577)

Turner Norman Clinard, Ph.D.
Vanderbilt University, 1956

Supervisor: Professor Claude P. Finney

Invented at the Court of Frederick II, the sonnet, apparently derived from Sicilian popular song by Giacomo da Lentino, was three hundred years old when Sir Thomas Wyatt imported it into English. At first exclusively a love song, it gradually became as popular for occasional poetry. The first sonnets included fourteen hendecasyllabic lines with alternating rime for four distichs, followed by two tercets. After three centuries' experimentation quatrains had replaced distichs in the first eight lines and enclosed rime had exceeded alternating in popularity. By the fifteenth century Guinizelli had heightened medieval love conventions with Platonic philosophy, Dante had written the first sonnet-sequence, and Petrarch had won the sonnet European acclaim with his Canzoniere.

Wyatt had the difficult task of accommodating this exotic form to English use. The Italian language and poetic line were flowing and syllabic, the English accentual. The Italian line had eleven syllables, a length unnatural to English. Italian had abundance of riming sounds, English a dearth.

Wyatt changed from two-quatrain and two-tercet structure to three-quatrains and couplet. He loosened rime-schemes and sought an English equivalent for the hendecasyllable. In translating he kept close to the Italian with lines ranging from nine to twelve syllables. Most of his translated lines are decasyllabic but not pentametric.

In original sonnets Wyatt wrote in consciousness of many rhythmical traditions. The accentual tradition was strongest; even lyrical lines were more careful of accents than syllables. Wyatt wrote one sonnet in lilting "Skeltonic" four-beat lines ranging from seven to eleven syllables, several sonnets employing the "broken-backed heroic" of four to six beats and several regular iambic pentameter sonnets, combining again the syllabic and accentual traditions to produce the lost Chaucerian line. But on most of his sonnets he imposed a still stronger force: the force of rhythmical speech units varied by pause and duration. Alliteration, rhetoric, music contributed. To appreciate Wyatt's rhythms one must forget the misconception that he always "intended" iambic pentameters. He was a master of conversational rhythm in the poetic line, manipulating monosyllabic language for the best rhythmical and emotional effects.

Though Petrarch was his teacher in sonneteering, Wyatt was far more English than Petrarchan. He used the Petrarchan conceits of love, but he employed them to complain of his personal fortunes and often poked fun at love. He knew Platonic love philosophy, but it did not inform his sonnets. Wyatt wrote few love sonnets, indeed.

His sonnets are simple in diction, forceful and dramatic. He is highly original and humorous. Donne could have learned much of language, metrics, and drama from Wyatt's practise. Wyatt was neither Petrarchan nor Elizabethan in spirit; he is more like Donne.

Surrey was a "smoother" sonneteer who wrote only iambic pentameter lines. His diction was more liquid, his imagination more pictorial, his lines more neatly rhetorical. He is more Petrarchan and more Platonic in spirit than Wyatt. Besides love sonnets he also wrote sonnet elegies and tributes, less moving than Wyatt's but disciplined in rhythm and form. A close student of Wyatt, Surrey took his three-quatrain and couplet structure, alternating rime, and the practise of adding new rimes in each sonnet division and combined them into the "Shakespearean" form. His constant use of Wyatt's pentameter line helped to make it standard for the English sonnet.

Sonnets of Nicholas Grimald and other "uncertain authors" also appeared in Tottel's Miscellany (1557). In the early years of Elizabeth, Tusser, Sackville, and Googe wrote one to three sonnets each, and a few appeared in the miscellanies. All have their roots in Songs and Sonnets; none shows any progress over Wyatt and Surrey. From Surrey to Sidney came an interregnum in English poetry when true sonnets were not distinguished from other short lyrics. The few sonnets extant are drab and unexciting poetry.

331 pages. $4.14. Mic 56-1792

A CASE STUDY OF BOOTH TARKINGTON AS A NOVELIST

(Publication No. 16,748)

Keith John Fennimore, Ph.D.
Michigan State University, 1956

Throughout the major portion of the past half-century one of the most successful novelists in American letters was Booth Tarkington. As inheritor of the Howells-James-Wharton tradition of realism, he adhered to a literary code which the emergent school of Naturalism condemned as romantic and sentimental. With the early call of Naturalism for artistic truth Tarkington was in sympathy, but he soon deplored its stylistic excesses and thematic liberties. He likewise opposed its cynical tone and pessimistic attitudes; in particular he eschewed the human degradation and violence which mark so many Naturalistic novels.

By temperament Tarkington was an optimistic progressivist with an abiding confidence in his fellow men and their ability to direct change into improvement. Beyond the turmoil of recurrent militarism and economic distress he envisioned a paternalistic capitalism which he considered America's supreme endowment to posterity. As a formative influence he felt that the novel offers the widest opportunities for social service in the hands of a sincerely motivated writer.

The principal objectives of this case study thus become: (1) an analysis of Tarkington's social doctrine, (2) his placement in the literary scene during his career, (3) the codification of his principles as a craftsman, and (4) a clarification of his literary ideals. No attempt at a critical biography is made; no chronological history of his literary development is projected. Whereas stylistic growth is indicated for expository purposes in some phases of the investigation, the discussion generally centers upon the mature novelist.

Although Tarkington himself was proud of his preëminent position among the popular writers of his profession, literary scholars are more prone to belittle him for that very popularity. They cannot wholly ignore him in their histories of contemporary American literature, but they maintain a discreet silence about him in their academic journals. As a result the student of Tarkington must go outside his usual resources for much of his material. Thus he resorts frequently to household magazines, he cites opinions from newspapers, he quotes from interviews, and employs other evidence of a similar nature.

This problem of evidence is especially complicated in the case of Tarkington because of his reticence in appearing in the role of critic. Only rarely did he make pronouncements of a critical nature on the art of fiction, and these lie scattered among a miscellany of brief articles, prefaces, autobiographical fragments, and short stories. Nowhere is there a coherent or comprehensive expression of his philosophy of literature. One therefore must construct a somewhat unadorned frame of reference from Tarkington sources, then embellish it with illustrations from his works or comments from kindred authors who expressed themselves more volubly. This latter expedient is not as dangerous as it may seem, for the student of Tarkington soon learns the basic tenets of his subject's literary idealism from both the positive and the negative evidence of the writings themselves and needs only to supply their interpretation.

The further one penetrates the Tarkington concept of literature and its role in society, the more one discovers for these critical times. It was his belief that the sincere novelist is a creative artist who owes it to the society which bred him to produce literary works which demonstrate the humanity of man, his courage, his faith. Evil the novelist cannot ignore, but good he must likewise portray; he should neither exploit the sordid nor eliminate the hopeful. There is an honest realism advocated by Tarkington which finds romance beyond the wedding vows and sentiment in us all. Most of his words may soon be forgotten, but his broad idealism stands forth as a worthy example for the inheritors of tomorrow.

320 pages. $4.00. Mic 56-1793

THE IMPACT OF THE "OLD" AND "NEW" ASTRONOMIES ON FRENCH POETRY FROM 1600 TO 1650

(Publication No. 16,354)

Beverly S. Ridgely, Ph.D.
Princeton University, 1953

The purpose of this study is to determine and explain the relationship between poetic expression and scientific thought in astronomy in France, during the period which experienced the most profound recorded change in man's conceptions of the universe and his position in the scale of creation.

This change involved, essentially, the replacement of the compact, finite, unique Aristotelio-Ptolemaic-Christian universe, whose spatial, philosophical, and theological centers were occupied by man, by a formless, infinite, perhaps multiply-inhabited universe, in which man fulfilled his destiny on an insignificant moving planet.

This gradual, difficult transformation, long brewing before Copernicus precipitated it in 1543, penetrated French thought very slowly. Until 1600 the astronomical "revolution" was generally ignored or rejected as absurd and was rarely given fair consideration. After 1610, through the growth of observational astronomy and learned societies and the prestige of Galileo, the savants and free-thinkers became increasingly receptive to every development. But knowledge, acceptance, and even discussion of the "new astronomy" were limited to the intellectual élite. Fortified by Aristotelian doctrines and the Church's stand that heliocentrism was a heresy, many scientists and most ecclesiastics pedagogues continued to oppose such heterodox notions as the earth's movement and the infinity of the universe. And due to Aristotelianism's unbroken hold on the schools and the lack until after 1635 of elementary vernacular publications explaining the Copernican system, the literate classes were largely unaware of the debates agitating the learned circles. By 1650 the "new astronomy" had important adherents among the savants and independents but was still rejected by philosophically- and theologically-confined minds and was just becoming known to the educated public.

The astronomical content of the poetry clearly reflects this situation. Material derived from official doctrines and traditional notions is divisible into three categories. In amorous, laudatory, and religious verse appear stylised,

conventional celestial conceits which indicate little as to the astronomical thought of an author or the age. In poetry of freer inspiration, however, occur positive allusions to every important concept of the "old astronomy," while some writers, like Racan, had a real personal interest in the heavens. Throughout the poetry are expressions of the almost universal contemporary acceptance of basic astrological doctrines and of the growing movement to discredit judicial astrology and its practioners and devotees. This definite and extensive reflection of traditional astronomical thought indicates a fundamental error in the usual generalization that the poetry of the period is marked by an absence of any awareness and interest in the heavens.

In comparison, references to modern astronomical developments are infrequent and incidental. They do reflect contemporary thought in dealing most often with the quarrel over the earth's mobility. And the semi-serious way in which they are handled by poets like Saint-Amant and Dalibray betrays a deliberate effort to destroy discredited pedantry and allow the truth to emerge without dogmatism, graciously yet firmly.

The apparent failure of the "new astronomy" to stimulate the French poetic imagination deeply contrasts sharply with its powerful effect on English poets. It is accountable to such factors as the less favorable conditions in France for the spread of the modern developments, the temperaments and situations of individual poets, the rise of the doctrine that poetry's main function was to please, and the interest in France in only those aspects of nature which man could understand and master.

But rather than cleavage, there was actually harmony between poetic expression and scientific thinking in France, for the order, proportion, and symmetry of the universe seen by the poets characterize also the basic ideals of an age which was evolving Cartesian rationalism in science and the Classical doctrine in literature.

470 pages. $5.88. Mic 56-1794

THE SEVEN ARTS CRITICS: A STUDY OF CULTURAL NATIONALISM IN AMERICA, 1910-1930

(Publication No. 14,780)

Claire Sacks, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Frederick J. Hoffman

The Seven Arts (1916-1917) significantly focuses the cultural nationalism represented by Randolph Bourne, Van Wyck Brooks and Waldo Frank. His contiguous point of view and personal testimony relate a fourth critic, Lewis Mumford, to the Seven Arts group. Like many of their contemporaries, the four cultural critics assumed the dissociation of modern society and the inadequacy of prevailing literary tradition. Unlike such contemporaries as T. S. Eliot and Ezra Pound, the literary "radicals" specifically concentrated on the American scene in an ambivalent effort to determine the causes of American cultural failure and salvage from that failure a usable literary past.

An assessment of their criticism involves a definition of cultural nationalism, a study of the critical work of Bourne, Brooks, Frank and Mumford, as well as of the Seven Arts, and current or subsequent kindred periodicals such as the Dial (1916-1920), the Freeman (1920-1924), and The American Caravan (1927-1936).

Although Mumford decries the appropriation of a political abstraction for literary purposes, his commitment to the theory of the organic society as the locus of great art relates him to the Seven Arts critics. For all four critics alteration of the American psychology consequently precedes literary criticism. The negative ordering of the American cultural past, conveniently embodied in the Puritan-pioneer-industrial triad, is redeemed by a belief in future promise. Future orientation, like the search for a satisfactory past, is a natural concomitant of the near-messianism of cultural nationalism. Pre-Civil War America, not an ideal society, nevertheless achieves some sufficiency by contrast with centralized, mechanized post-Civil War America. From this relatively homogeneous society, the cultural critics extract their most pertinent evidence of America's literary potentialities. Whitman particularly functions as the bard of national possibility. Between the Golden Day and the current literary renaissance falls the shadow. When the search for literary promise centers on the present, few writers escape the charge of negativism, sterility or disillusion. In fact, as the twenties wear on, earlier support of Sherwood Anderson and some non-expatriate poets is not carried over to a younger literary generation. Despite Hart Crane's intense implication in the myth of America, Frank alone shows himself capable of precise critical response to his work.

Bourne, dead in 1918, best illustrates the group's alliance with political liberalism and its attempt to redirect vulgar nationalism to creative ends. Brooks's exhortations stem from a highly simplified version of literature as ideas or social salvation. Although no Seven Arts critic combines the judicious mind of Mumford with the poetic sensibility of Frank, their work may stand for cultural criticism at its best. As intrusive as Frank's mysticism often is, his criticism nevertheless saves the Seven Arts critics from the charge of total poetic obtuseness.

Their generally unhistorical ordering of the American past notwithstanding, the Seven Arts critics presented an acute criticism of American inadequacies when such criticism was unfamiliar and subversive of "uplift" psychology. The search for a usable literary past was a salutary corrective to academic indifference toward and general public ignorance of American literature. Unfortunately the extrinsic demand that literature reflect the dual vision of American failure and promise led away from literature; the theory of the organic society rationalized this distance. Instead of presenting a precise literary program, the Seven Arts critics urged writers to reflect their generalized faith in American promise. Ironically enough, American promise becomes the escape clause in an incompletely realized ideal of criticism engagée.

377 pages. $4.71. Mic 56-1795

THE EXPRESSED OPINIONS OF MARK TWAIN ON HEREDITY AND ENVIRONMENT

(Publication No. 14,781)

J. Harold Smith, Ph.D.
The University of Wisconsin, 1955

Supervisor: Professor Henry A. Pochmann

Heredity and Environment in Mark Twain poses the twofold problem of finding a working definition out of the miscellaneous elements of human nature that he treats, and of handling an environment that is virtually limitless in variety and extent. Heredity and environment as such do not become elements of focus until the closing years of the nineteenth century when Twain worked out his system of evolutionary determinism.

Mark Twain was so unique in his own person and experience, and his writings are so often projections of his own experience and thought, that the impact of heredity and environment in his own life must be analyzed before one can expect to understand the man and his writings. In his successive adjustments to a variety of environments, Mark Twain developed on the foundations of his native wit an oral and written technique that capitalized on the jolt of mirth one feels when confronted with the juxtaposition of unexpected contrasts. This "pure fooling" goes far toward explaining Mark Twain's obsession with problems of duality, superstition, mystery, and the general enigma of life. His attitude toward mankind was ambivalent. He was both attracted to, and repelled by, what he saw. He witnessed too much of the peripheral in human experience, he surfaced too much in the shallows of extra-ordinary experience, he was too much overwhelmed by the tragic event, to make possible a calmly reasoned view of life.

To understand Mark Twain's concept of human nature, including heredity, man must be viewed in relation to his several environments--physical and economic, political, social, religious, and moral. During the earlier and middle years, Twain's focus is on the social man--man hastening to exploit the riches of mining or commercial frontiers, man bowing to the vitiating force of social pressures or oppression, whether in political, moral, or religious practices.

Mark Twain never employed the term heredity in its strict sense as the transmission of those traits which are carried through the genes of the chromosomes occupying the blood stream. The terms in his usage that would correspond most nearly with that meaning are one's make and temperament.

For Mark Twain the term environment comprehended those directing and limiting agencies operating on man from the outside. His terms are successively: training, outside influences and associations, circumstances and environment. Operating medially between the two powerful forces temperament (strict heredity) and circumstances (environment), have been "heredities," a term that in Twain's evolutionary doctrine refers not only to inborn traits passed on from generation to generation, but also those traits distinctive to man that have been acquired in successive adaptations to environment. This is evolutionary determinism.

As regards man's experience (since evolving from the lower forms), my conclusion is that Mark Twain purposely intended to show that man is a "creature" or "victim" of both heredity and environment--of hereditary determinism and environmental determinism. He is driven by forces from within and limited or directed by circumstances from without. Because of the predominance given to the Moral Mechanism, which in Twain's theory is controlled by a Master Passion that seeks above all else Self-Approval and Self-Contentment, naturalistic behaviorism is suggested as a descriptive term.

Moral retrogression that has resulted from the "gift" of imagination that distinguishes man from animals is the basis of Twain's denial of moral responsibility. Heredity and environment take no account of the soul. The nearest approach comes when the Old Man of What Is Man? replies, to a query of the Young Man, that no one can know whether or not the Me is the Soul.

413 pages. $5.16. Mic 56-1796

JEWISH CHARACTERS IN THE AMERICAN NOVEL TO 1900

(Publication No. 16,778)

Abraham H. Steinberg, Ph.D.
New York University, 1956

Adviser: Professor Oscar Cargill

This dissertation undertakes, in the absence of any other preliminary account, to provide a panoramic view of the treatment of the Jew in the American novel up to and including the year 1900. Jewish characters appeared as early as the eighteenth century, when the novel form was just taking root in our soil, and in works by such nineteenth century authors as Cooper, Simms, Hawthorne, James, and hosts of others. An attempt is made to convey something of the flavor of the approximately 250 novels surveyed, as background for a brief scrutiny of their handling of Jews.

The study is divided into two parts, the subdivisions following a roughly chronological sequence. The first part embraces novels in which religion is the significant theme; the second part includes secular novels. Most of the novels of the first part were inspired by the Bible; they are classified into two groups, the first set in Old Testament days, the second in Christian times. Separate chapters are devoted to biblical best sellers by William Ware, Joseph Holt Ingraham, and Lew Wallace; to novels retailing the conversion of Jews to Christianity in contemporary America; and to religious novels by Jewish authors, notably Isaac Mayer Wise.

The final chapter of Part One essays a definition of the rationale of the treatment of the Jew in religious novels. Dictated in large part by the presumed requirements of vulgar apologetics, a familiar characterology beheld the Old Testament Hebrew as a virtuous patriarch, a tall, bearded, stiff-necked warrior whose prodigious might was dedicated to the defense of the just law which was the will of God. The prevalent interpretation held that the good and true Jews became Christians; while the unsaved remnant, anticipating the restoration of a material kingdom, forsook their spiritual goals for the accumulation of wealth. Thus was the stereotype of the tall Hebrew warrior supplanted by that of an ineffective, little, miserly Jew, whose pretended humility concealed the resentments and delusive hopes of his broken spirit. Apparently self-assertiveness

took a less threatening shape in the Jewess, who more often appeared as a creature of unrestrained passions. These assumptions about Jewish character proceeded from an unfavorable view of Jewish religion; but an occasional exception like Ben-Hur (1880), the most successful novel of its genre, beheld Judaism not as a threatening rival but as Christianity's worthy if absolescent ancestor.

Part Two opens with an examination of the Jews of cheap literature, dime novels, and the productions of Mrs. E. D. E. N. Southworth and the less well known Richard Henry Savage. Jews were persistently conceived as foreigners and were frequently encountered in American novels set abroad. Harold Frederic's Gloria Mundi (1898) describes a social experiment in England based on the over-protective qualities he associated with Jewish family life; and Jews took part in a number of lesser reformist and utopian novels. Miriam, of Hawthorne's The Marble Faun (1860), is interpreted in terms of the popular image of the Jewess; while Miriam, of James's The Tragic Muse (1890), is seen as epitomizing in the figure of the Jewess the author's complex feelings about passion, art, and humanity in general. A chapter is assigned to Henry Harland, a Christian who, under the Jewish-sounding pseudonym "Sidney Luska," wrote realistically of Jewish life. The final chapter relates novels by Jewish authors to the larger perspectives of the American scene, emphasizing such unjustly neglected works as Nathan Mayer's Differences (1867), and Emma Wolf's Other Things Being Equal (1892) and Heirs of Yesterday (1900).

308 pages. $3.85. Mic 56-1797

RICARDO GÜIRALDES, ARGENTINO (1886-1927)

(Publication No. 15,073)

Harry Weiss, Ph.D.
Syracuse University, 1955

In spite of the fact that Ricardo Güiraldes has been considered a classic in Argentine literature since the appearance of his Don Segundo Sombra, in 1926, no study embracing all of his writings has yet been made to define the nature of his thinking and its effects upon his art.

Numerous impressionistic comments on his person and works, some individual studies -- practically all centering about Don Segundo -- have tended to transform Güiraldes into a myth, and in so doing have left an incomplete portrait of the man and the artist. The present study attempts to dispel the nebula, to find the basic features of Güiraldes' personality and thinking, and to ascertain to what extent they gave form and unity to his work. All of Güiraldes' writings have been used for this purpose -- those that have enjoyed wide circulation, as well as those that have remained almost unknown, including that bibliographical rarity, key to a proper understanding of Güiraldes, El sendero. In addition to his artistic and theoretic writings, as well as many notations of a more openly autobiographical nature, the most complete bibliography of critical comment gathered to date for a study on Güiraldes has been used.

The first chapter of our study traces Güiraldes' brief career as a writer, while the second is concerned with his activities among the young writers who made up the Generation sometimes known as that of 1922, of Martín Fierro, or of Florida and Boedo. Güiraldes' literary ideals and those of the escritores jóvenes are considered.

The third chapter, "Argentina the Ideal," demonstrates that the works of Güiraldes -- short stories and novels, and even some of the poems -- constitute a panorama of Argentina in evolution; that contrary to what has hitherto been held, Güiraldes' achievement lies not alone in the creation of the symbol of his nation's personality of the past and the portrait of her past way of life, but also in his attempt to create the symbol of her future personality, and in his effort to indicate the proper course for approaching the new way of life. Güiraldes felt that the evolutionary movement was at times too rapid -- that eagerness for change without preparation for it might result in greater harm than benefit. Like some of the idealists and philosophers of the Spanish Generation of '98, he suggested a careful advance -- combining the best of national tradition with the highest values of foreign culture. Güiraldes himself was a living example of the ideal personality of the future.

The fourth chapter, "Between Rationality and Spirituality," is dedicated to the study of Güiraldes' evolution along the path of spirituality. Devoted to a life of materialism and sensuality in his early years, his interest in the French Symbolist movement in literature, physical suffering and the wide-spread disappointment brought by the first World War, soon directed Güiraldes' gaze towards the Orient in search of more abiding moral values. He became immersed in theosophical and Hindu readings, and thus awakened and strengthened a spirituality the beginnings of which had been latent in him since his childhood on the Pampa. He made of morality the path towards total knowledge and the spiritual plane. Güiraldes' true interest, however, lay not in the attainment of the goal, but in continuous advance along the path. Attainment of universal knowledge implied the cessation of further striving and death of the earthly personality -- a fact to which in the last analysis, Güiraldes could not become reconciled. Güiraldes has repeatedly been designated as a Christian poet. The error contained in such a designation becomes manifest when Güiraldes' Buddhistic concept of God, his inclination toward a philosophic, non-sectarian religion, as well as his views on love and death are considered. Güiraldes could not emerge from the struggle between materialism and spirituality -- between rationality and intuitionism.

"Politics and Society," the fifth chapter, points to the fact that Güiraldes, aware of his own capacity for higher moral conduct, felt that a similar capacity was implicit in his nation. Güiraldes was convinced that an improvement was necessary in some aspects of Argentine social life -- in politics, education, the relation between men and women. He was especially concerned with a tendency towards violence apparent in the national character and recurrent in the traditional way of life. He looked forward to a rational, self-imposed, generous morality in his people.

The chapter on "Technique and Techniques" focuses attention upon the general structural lines of Güiraldes' works, and on some specific features of technique which are revelatory of Güiraldes' manner of apprehending the universe and indicative of the nature of his subject -- the evolution of Argentine society. The fluidity of serial structure in his short stories and novels best reflects the

panorama that Güiraldes undertook to re-create. The basic elements on which the novels and short stories usually depend are three: the depiction of natural phenomena, folklore, and a rudimentary plot intended to display the operation of the Argentine character within the process of social evolution. Güiraldes' tendency to group structural elements in series of three or multiples of three is particularly evident in Don Segundo Sombra.

Güiraldes' personality and art stemmed from and served his great love: Argentina. Güiraldes is beginning to occupy a deservedly solid place in world literature -- a fact which confirms his belief that the surest approach to universality lay in interpreting the depths of himself and of his nation. 236 pages. $2.95. Mic 56-1798

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

A MIXED BOUNDARY POTENTIAL PROBLEM ARISING FROM A PROBLEM IN SHIP MOTION

(Publication No. 16,771)

Meyer Jordan, Ph.D.
New York University, 1956

Adviser: Professor Arthur S. Peters

A function $X(r,\theta,y)$ is sought with the following properties:

1. $X_{rr} + \frac{1}{r} X_r + \frac{1}{r^2} X_{\theta\theta} + X_{yy} = 0$

for $y < 0$, except on $\theta = 0$ and on $\theta = 2\pi$.

2. $$L[X] = \{s_0^2[\cos^2\theta \frac{\partial^2}{\partial r^2} - \frac{\sin 2\theta}{r} \frac{\partial^2}{\partial r \partial \theta} + \frac{\sin^2\theta}{r^2} \frac{\partial^2}{\partial \theta^2} + \frac{\sin^2\theta}{r} \frac{\partial}{\partial r} + \frac{\sin 2\theta}{r^2} \frac{\partial}{\partial \theta}] - 2is_0\Omega[\cos\theta \frac{\partial}{\partial r} - \frac{\sin\theta}{r} \frac{\partial}{\partial \theta}] + g \frac{\partial}{\partial y} - \Omega^2\} X(r,\theta,y) = 0$$

on $y = 0$.

3. $X = r\, f(r,y)$

on $\theta = 0$ and on $\theta = 2\pi$. The function $f(r,y)$ is prescribed.

4. $X(r,\theta,y) \sim \exp\{\frac{\sigma^2}{g}[y + ir\cos(\theta - a)]\}$

for large r.

The problem is divided into two parts, the homogeneous problem, with solution $X_H(r,\theta,y)$, satisfying properties 1, 2, 3 (with $f(r,y) \equiv 0$), and 4; and the inhomogeneous problem, with solution $X_I(r,\theta,y)$ satisfying properties 1, 2, 3 (with $f(r,y) \not\equiv 0$), and with $X_I(r,\theta,y) \longrightarrow 0$ as $r \longrightarrow \infty$. The solution $X(r,\theta,y)$ of the problem is then given by

$$X(r,\theta,y) = X_H(r,\theta,y) + X_I(r,\theta,y) \ .$$

In the homogeneous problem, the techniques of Fourier transforms, separation of variables, and the use of various trigonometric and Bessel identities reduce the problem to a homogeneous difference equation, which is solved to yield

$$X_H(r,\theta,y) = \exp(\frac{\sigma^2 y}{g}) \sum_{n=0}^{\infty} \epsilon_n \exp(\frac{in\pi}{4}) J_{\frac{n}{2}}(\frac{\sigma^2 r}{g}) \cos\frac{na}{2} \cos\frac{n\theta}{2} \ .$$

In the inhomogeneous case, the function $X_I(r,\theta,y)$ is written as the sum of two functions

$$X_I(r,\theta,y) = u(r,\theta,y) + v(r,\theta,y) \ ,$$

where $u(r,\theta,y)$ has properties 1 and 3, and where $u = 0$ on $y = 0$; so that $v(r,\theta,y)$ has property 1; $L[v] = -g\, u_y(r,\theta,0)$ on $y = 0$; and $v_\theta = 0$ on $\theta = 0$ and on $\theta = 2\pi$.

The function $u(r,\theta,y)$ is found by constructing a Green's function

$$G(r_0,\theta_0,y_0;r,\theta,y) = \frac{1}{\pi} \sum_{n=0}^{\infty} \epsilon_n \cos\frac{n\theta}{2} \cos\frac{n\theta_0}{2} \int_{-\infty}^{\infty} \exp[iq(y-y_0)] \cdot \int_0^{\infty} \frac{J_{\frac{n}{2}}(rp)\, J_{\frac{n}{2}}(r_0 p)\, p\, dp\, dq}{p^2 + q^2}$$

for the space bounded by the half plane $z = 0$, $x > 0$. Setting

$$G^*(r_0,y_0;r,\theta,y) = G(r_0,0,y_0;r,\theta,y) - G(r_0,2\pi,y_0;r,\theta,y),$$

and using Green's second identity determines $u(r,\theta,y)$.

$$u(r,\theta,y) = -\frac{1}{4\pi} \int_{-\infty}^{0} \int_{0}^{\infty} [G^*(r_0,y_0;r,\theta,y) - G^*(r_0,-y_0;r,\theta,y)] \cdot f(r_0,y_0)\, dr_0\, dy_0 \ .$$

The function $v(r,\theta,y)$ is found through the use of an auxilliary function

$$w(r,\theta,y) = L[v(r,\theta,y)] \ ,$$

where L is the differential operator given by 2. After $w(r,\theta,y)$ is found, the assumption that $v(r,\theta,y)$ has the same form as $w(r,\theta,y)$, the use of the relation $L[v] = w$, and the various trigonometric and Bessel identities used in the homogeneous case, together with the technique of Fourier transforms, reduces the problem to an inhomogeneous difference equation, which is solved to yield

$$v(r,\theta,y) = \frac{g\cos\frac{\theta}{2}}{2\pi^3} \int_{-\infty}^{0} \int_{0}^{\infty} \int_{0}^{\infty} \int_{P'} \int_{P} \frac{f(r_0,y_0)(zz')^{-\frac{1}{2}}(1-zz')}{(zz')^2 - 2zz'\cos\theta + 1} \cdot \frac{\exp[p(y+y_0) - \frac{rp}{2}(z' - \frac{1}{z'}) - \frac{r_0 p}{2}(z - \frac{1}{z})]}{\frac{s_0^2 p^2}{4}(z - \frac{1}{z})^2 - is_0 p\Omega(z - \frac{1}{z}) + (gp - \Omega^2)} \cdot p\, dz'\, dz\, dp\, dr_0\, dy_0 \ .$$

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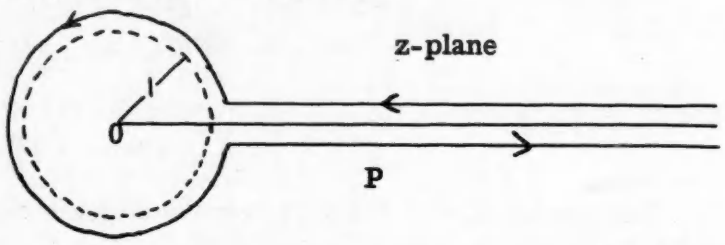
The path P in the z-plane is



P′ is the same path in the z′-plane as P is in the z-plane.
33 pages. $1.00. Mic 56-1799

ON THE CONVERGENCE OF SEQUENCES OF STOCHASTIC PROCESSES WITH INDEPENDENT INCREMENTS

(Publication No. 16,557)

Ernest Godfrey Kimme, Ph.D.
University of Minnesota, 1956

The problem discussed is the following; If $\{X^{(n)}_{t_1}\, t\epsilon[0,1]\}$ is a sequence of real separable stochastic processes with independent increments, a) does there exist a concept of convergence for such a sequence, b) does convergence imply the existence of a (real) limiting process, c) what are the properties of such a limiting process, and d) does convergence of the processes $\{X^{(n)}_{t_1} t\epsilon[0,1]\}$ to a limiting process $\{X_{t_1} t\epsilon[0,1]\}$ imply convergence in some sense of $\{E\{F[X^{(n)}_{(1)}]\}\}_n$ to $E\{F[X_{(1)}]\}$ where F[ ] is a real functional on the space $\mathfrak{B}$ of real functions on [0, 1]. Problem a) is answered with two modes of convergence, the first being in strict analogy to ordinary convergence in distribution of sequences of distribution functions: the processes are said to converge in distribution if $\exists\, \phi_t(\mu)$, a characteristic function for each $t\epsilon[0,1]$, $\ni \lim_{n\to\infty} E\{\exp i\mu x^{(n)}_t\} = \phi_t(\mu)$. The processes are said to converge uniformly in distribution if $\lim_{n\to\infty} E\{\exp i\mu x^{(n)}_t\} = \phi_t(\mu)$ uniformly for

$$(t,\mu)\epsilon[0,1]\otimes[-M,M]\ ,$$

for any $M > 0$. It is shown in answer to b) that convergence of $\{X^{(n)}_{t_1}\ t\epsilon[0,1]\}$ in distribution implies the existence of a limiting process, and c) is answered by showing that the limiting process may be assumed separable, and has no fixed points of discontinuity if the convergence is uniform convergence in distribution. The question d) is answered by showing that under certain minimal continuity hypotheses on F[ ] (depending on the nature of almost all sample functions of the limiting process), uniform convergence in distribution of $\{X^{(n)}_{t_1}\ t\epsilon[0,1]\}$ to $\{X_{t_1} t\epsilon[0,1]\}$ implies $\lim_{n\to\infty} E\{F[X^{(n)}_{(1)}]\} = E\{F[X_{(1)}]\}$ and in fact

$$\lim_{n\to\infty} p\{F[X^{(n)}_{(1)}] \le \lambda\} = p\{F[X_{(1)}] \le \lambda\}$$

for continuity points λ of the latter distribution function; the latter result applies with weaker restrictions on F[ ] than the former. If $\{X_{nk}\}_{k=1}^{k_n}$, $n = 1,2,\cdots$ is a sequence of finite sequences of independent random variables, sufficient conditions are exhibited for the uniform convergence in distribution of the processes given by

$$X^{(n)}_t = \sum_{k=1}^{[t\,k_n]} X_{nk}\ ,\quad t\epsilon[0,1]$$

the conditions depending on Gnedenko's theorem on ordinary convergence in distribution of the sums $\sum_{k=1}^{k_n} X_{nk}$. The force of the limit theorems obtained is exhibited in a calculation of the distribution of the random variable $\int_0^t X_s ds$ on a separable stochastic process with independent increments and no fixed points of discontinuity; the known result on the Wiener process follows as a special case.

The method of attack is in part one developed by Kac-and-Erdös in two papers in the Bulletin of the American Mathematical Society (52, 1946; 53, 1947), for the proofs of some limit theorems of the type discussed above for some specific functionals. Donsker and Udagawa subsequently extended their results, again using the fundamental device used by Kac-and-Erdös. The extension to a general class of functionals is obtained by a technique of functional approximations developed by Donsker [Mem. A.M.S., 6]. 134 pages. $1.68. Mic 56-1800

A METHOD OF APPROACH TOWARDS THE SOLUTION OF THE PROBLEM CONCERNING THE EXISTENCE OF AT LEAST ONE PRIME BETWEEN CONSECUTIVE PERFECT SQUARES

(Publication No. 13,767)

Walter Eugene Mientka, Ph.D.
University of Colorado, 1955

Supervisor: Professor Sarvadaman Chowla

This dissertation contains an approach to the solution of the famous unsolved problem concerning the existence of at least one prime between consecutive perfect squares.

Viggo Brun (1920), using elaborate methods, proved the following result in this direction. For large x there exists at least one positive integer between x and $x + \sqrt{x}$ with at most 11 prime factors. The method used in this thesis enables us to replace the number 11 by 9, a result which can probably be improved by the same method. However, in obtaining this result, heavy calculations were avoided since the emphasis is more on the method which is applicable to other unsolved problems such as Goldbach's Conjecture and the existence of an infinite number of prime twins. 24 pages. $1.00. Mic 56-1801

THE POLYNOMIALS GENERATED BY f(t) exp (p(x)u(t))

(Publication No. 16,763)

Frank Joseph Palas, Ph.D.
The University of Oklahoma, 1956

A differential equation in explicit form is obtained for the polynomials generated by g(x,t) = f(t) exp (xu(t)) where f(t) and u(t) are power series with suitable restrictions.

A k-set of polynomials is defined as a sequence of polynomials $\{P_{kn}(x)\}$ such that $P_{kn}(x)$ is of degree exactly kn, $n=0, 1, 2, \cdots$. A linear differential operator $L(x,D)$ is developed which has the property that $L[P_{kn}(x)] = P_{k,n-1}(x)$, $n=1, 2, \cdots$. The class of k-sets $\{Y_{kn}(x)\}$ is characterized by the generating function

$$g(x,t) = f(t)\ \exp\ (p(x)u(t))\ ,$$

where p(x) is a polynomial of degree k such that p(O) = O, and f(t) and u(t) are power series. This class of k-sets is shown to satisfy several recurrence relations and a functional equation involving the operator L(x,D). The k-sets of polynomials are classified by means of the recurrence relations as B_k-type and C_k-type in analogy with Sheffer's B and C type classes. The equivalence of the B_k-type and C_k-type classes is shown. In addition the relation between the $\{Y_{kn}(x)\}$ k-sets and sets defined by Huff is shown.

Several particular k-sets are presented. Included are a k-set whose corresponding operator is $L(x,D) = D^k$ and another which is characterized by $g(x,t) = \exp(x^k t)$. In addition the set $\{Y_{2n}(x)\}$ is presented in some detail. The corresponding operator L(x,D) is obtained in explicit form and found to be Sheffer infinite A-type. The differential equation for this 2-set is shown to be necessarily of infinite order.

In 1923, Humbert discovered a 2-set which satisfies a Rodrigues' formula analogous to the formula for the Laguerre polynomials. A k-set $\{T_{kn}(x)\}$ is characterized by a generating function and is shown to satisfy a Rodrigues' formula $T_{kn}(x) = \exp(x^k)D^n[x^n \exp(-x^k)]/n!$ The proof that the k-sets given by the generating function and the formula are equivalent is accomplished by an induction which makes use of a recurrence relation for $T'_{kn}(x)$ which involves 2k terms. The $\{T_{kn}(x)\}$ k-set is a $\{Y_{kn}(x)\}$ k-set and has the property that the 0, 1, $\cdots$, n - 1 moments of $\exp(-x^k)T_{kn}(x)$ vanish. When k = 1 this set is the Laguerre set and the property of vanishing moments is equivalent to orthogonality. 54 pages. $1.00. Mic 56-1802

A QUARTIC HYPERSURFACE INVARIANT UNDER THE COLLINEATIONS OF THE SIMPLE GROUP OF ORDER 660 IN SIX VARIABLES

(Publication No. 16,524)

Charles Frederick Sebesta, Ph.D.
University of Pittsburgh, 1956

The purposes of this study are to obtain a quartic hypersurface invariant under the collineations of the group of order 660 in six variables and to determine geometric configurations which have definite relations to the invariant hypersurface.

The group G is generated by the transformations R and S where R is of order two and S is of order 11. They permute among themselves the positive and negative values of the 12 linear forms $\sqrt{-11}\ x_1$ and

$$x_1+w^n x_2+w^{4n} x_3+w^{5n} x_4+w^{9n} x_5+w^{3n} x_6$$

where $w^{11}=1$ and $n=1,2,\ldots,11$. The sum of the fourth powers of these 12 forms equated to zero gives the equation of a quartic hypersurface

$$x_1^4+x_2^2(x_1x_5+x_3x_4)+x_3^2(x_1x_6+x_4x_5)+x_4^2(x_1x_2+x_5x_6)$$
$$+x_5^2(x_1x_3+x_2x_6)+x_6^2(x_1x_4+x_2x_3) = 0$$

which is invariant under the transformations of G. The 12 linear forms equated to zero constitute a set S_1 of 12 hyperplanes.

The transformation T of order five is an element of the group G. The characteristic equation of T yields the distinct eigenvalues $1,\theta,\theta^2,\theta^3$, and θ^4 where $\theta^5=1$. Associated with these eigenvalues are certain eigenvectors. Taking the components of the vectors as successive coefficients of linear forms in six variables x_1 to x_6, and equating these forms to zero, there is obtained a set S_2 of hyperplanes. The intersection of two of these hyperplanes and two hyperplanes of the set S_1 is a bitangent to the invariant quartic hypersurface. There are two sets, S_3 and S_4, of 66 bitangents each, which are permuted among themselves by the generators of G. The points of contact of the bitangents form two sets, S_5 and S_6, of 132 points each.

The hyperplanes tangent to the invariant quartic hypersurface at the points of S_5 and S_6 form two sets, S_7 and S_8, of 132 hyperplanes each under the transformations of G. Two of these hyperplanes pass through each bitangent of S_3 and S_4.

The lines formed by the intersection of certain hyperplanes are shown to be tangents to the invariant quartic hypersurface. There is a set S_9 of 60 such tangent lines. The points of contact of the tangents constitute a set S_{10} of 60 points, five of which lie in each hyperplane of S_1. These 60 points are permuted in 12 sets of five points each by the transformations of G.

The intersections of certain hyperplanes form planes which have definite relations to the invariant quartic hypersurface. Each plane contains two of the tangents of the set S_9 and two of the points of the set S_{10}. Also, each plane belongs to a set S_{11} of 60 planes. Five of the planes of the set S_{11} intersect at a point which belongs to a set S_{12} of 12 points.

The intersection of the five planes of the set S_{11} may be considered as the vertex of a hexahedroid whose base vertices are five points of the set S_{10}. This hexahedroid belongs to a set S_{13} of 12 hexahedroids. The vertices of these hexahedroids are the points of the set S_{12}, and the base vertices are the points of the set S_{10}. The lateral edges are the tangent lines of the set S_9; the lateral faces, the planes of the set S_{11}; and the bases, the hyperplanes of S_1. The base edges of the hexahedroids form a set S_{14} of 60 lines which are rulings of the invariant quartic hypersurface.

The quadric hypersurface

$$4x_1^2+2x_1(x_2+x_3+x_4+x_5+x_6)+x_2x_4+x_2x_5+x_3x_5+x_3x_6+x_4x_6 = 0$$

contains ten points of the set S_{12}, the points of the set S_{10} which lie on two of the hyperplanes of S_1, and the points of contact of two of the bitangents. This quadric hypersurface is invariant under the transformations R and T of G, and it belongs to a set S_{15} of 66 such hypersurfaces.

The intersection of the plane $x_2=x_3=x_4=0$ and the quadric hypersurface is a conic which belongs to a set S_{16} of 60 conics, each containing five points of the set S_{10}. Five of these conics contain the base vertices of each of the hexahedroids. 31 pages, $1.00. Mic 56-1803

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ON THE INITIAL VALUE PROBLEM FOR SYSTEMS OF PARTIAL DIFFERENTIAL EQUATIONS WITH SEVERAL TIME-LIKE VARIABLES

(Publication No. 16,489)

Richard George Segers, Ph.D.
Purdue University, 1956

Major Professor: Michael Golomb

In Chapter I, we consider systems of partial differential equations of the form

$$(1)\quad \begin{cases} \dfrac{\partial U_i}{\partial s} = \sum\limits_{j=1}^{n} \sum\limits_{(k_s)} A_{ij}^{(k_1,\ldots,k_r)}(s,t)\, \dfrac{\partial^{k_1+\ldots+k_r} U_j}{\partial x_1^{k_1}\cdots\partial x_r^{k_r}} \\ \qquad + f_i(s,t;x_1,\ldots,x_r)\ ,\quad (i=1,\ldots,m) \\ \dfrac{\partial U_i}{\partial t} = \sum\limits_{j=1}^{n} \sum\limits_{(k_s)} A_{ij}^{(k_1,\ldots,k_r)}(s,t)\, \dfrac{\partial^{k_1+\ldots+k_r} U_j}{\partial x_1^{k_1}\cdots\partial x_r^{k_r}} \\ \qquad + f_i(s,t;x_1,\ldots,x_r)\ ,\quad (i=m+1,\ldots,n) \end{cases}$$

where $\sum_{(k_s)}$ means summation over all integers $k_s \geq 0$, whose sum does not exceed a number M and all functions are defined for all real values of $x_1,\ldots,x_r$ and for s,t values in the rectangular region $0 \leq s \leq S$; $0 \leq t \leq T$. In addition we prescribe the initial values

$$(2)\quad \begin{cases} U_i(s,t;x_1,\ldots,x_r)\big|_{s=s_0} = \varphi_i(t,x_1,\ldots,x_r)\ , \\ \qquad (i=1,\ldots,m) \\ U_i(s,t;x_1,\ldots,x_r)\big|_{t=t_0} = \varphi_i(s,x_1,\ldots,x_r)\ , \\ \qquad (i=m+1,\ldots,n) \end{cases}$$

and solve the initial value problem for (1) for the U_i in the region $s_0 \leq s \leq S$; $t_0 \leq t \leq T$; $-\infty < x_k < \infty$ $(k=1,\ldots,r)$ (hereafter denoted as $R\overset{x}{s_0}t_0;ST$; its projection onto the st-plane denoted as $Rs_0t_0;ST$) with data functions (2) for every $(s_0,t_0) \in Roo;ST$. The s and t may be thought of as two time variables and the x as space variables.

The initial value problem for (1) $R\overset{x}{o}o;ST$ is said to be uniformly correctly set (u.c.s.) if the following two conditions are satisfied:

I. For every $(s_0,t_0) \in Roo;ST$ and every system of functions $\varphi_i(t,x)$ $(i=1,\ldots,m)$, $\varphi_i(s,x)$ $(i=m+1,\ldots,n)$ that together with all their partial derivatives with respect to any of the $x_1,\ldots,x_r$ up to and including a certain order L are bounded and continuous in $R\overset{x}{o}o;ST$ there exists a unique set of functions U_i that

a) are bounded and continuous in $R\overset{x}{s_0}t_0;ST$ together with all their partial derivatives that occur in (1)
b) satisfy (1) in the open part of $R\overset{x}{s_0}t_0;ST$
c) satisfy (2), i.e.,

$$\lim_{s\to s_0} U_i(s,t;s_0,t_0;x) = \varphi_i(t,x)\ (i=1,\ldots,m)$$

$$\lim_{t\to t_0} U_i(s,t;s_0,t_0;x) = \varphi_i(s,x)\ (i=m+1,\ldots,n)$$

II. There exists for every $\epsilon > 0$ a number $\eta > 0$ independent of s_0,t_0 such that the U_i in $R\overset{x}{s_0}t_0;ST$ change less than ϵ when the φ_i and their derivatives with respect to the $x_1,\ldots,x_r$ up to the order L change less than η.

When the $A_{ij}^{(k_1,\ldots,k_r)}(s,t)$ and $f_i(s,t,x)$ are sufficiently smooth the desired solution is obtained (and will be u.c.s.) by the use of Fourier methods and the principle of superposition when a certain condition, Condition A, is fulfilled. Condition A expresses a restriction on a fundamental set of solutions of a system of partial differential equations

$$(3)\quad \begin{cases} \dfrac{\partial \nu_i}{\partial s} = \sum\limits_{j=1}^{n} \sum\limits_{(k_s)} A_{ij}^{(k_1,\ldots,k_r)}(s,t)\,(i\alpha_1)^{k_1}\cdots(i\alpha_r)^{k_r}\nu_j\ , \\ \qquad (i=1,\ldots,m) \\ \dfrac{\partial \nu_i}{\partial t} = \sum\limits_{j=1}^{n} \sum\limits_{(k_s)} A_{ij}^{(k_1,\ldots,k_r)}(s,t)\,(i\alpha_1)^{k_1}\cdots(i\alpha_r)^{k_r}\nu_j\ , \\ \qquad (i=m+1,\ldots,n) \end{cases}$$

related to (1) by a Fourier transformation on the $x_1,\ldots,x_r$. The concept of a fundamental system of solutions, which in general is used for systems of ordinary differential equations but not for systems of partial differential equations is extended to the system (3) in order to avoid having to examine all possible solutions of (3) in deciding the validity of Condition A. When Condition A is violated, then the problem is not u.c.s. In addition to (1) we consider higher order systems which can be replaced by the first order system (1), by the introduction of new unknowns for all but the highest order derivatives of the u_i with respect to s or t. It follows that all of our preceding work suffices to decide the same questions for these higher order systems.

In Chapter II we investigate the question of the fulfillment of Condition A when the $A_{ij}^{(k_1,\ldots,k_r)}$ are constants. After obtaining contour integral representations of the fundamental system of solutions of (3), two important special cases are treated in detail. The primary difficulty in checking Condition A turns out to be an asymptotic estimation for the fundamental system of solutions of (3) for large values of the α_i. Using the results of this chapter, an example of an initial value problem which is correctly set but not uniformly correctly set is exhibited.

The extension of the results of Chapters I and II to systems of the form (1) with N time-like variables is carried out in Chapter III. 128 pages. $1.60. Mic 56-1804

A POTENTIAL PROBLEM CONNECTED WITH AN INFINITE DOCK IN A RUNNING STREAM

(Publication No. 16,777)

Robert A. Spinelli, Ph.D.
New York University, 1956

Adviser: Professor J. J. Stoker

After a brief discussion of the exact formulation of the problem of a ship moving into a sea of waves in three dimensions, a specific potential theory problem is arrived at. This is the determination of a function, $\psi(x,y)$ which satisfies the following conditions:

(1) $\Delta\psi = 0$, $y < 0$
(2) $k\psi_y + \psi_{xx} = 0$, $y = 0$, $x > 0$, $k > 0$
(3) $\psi_y = f(x)$, $y = 0$, $x < 0$
(4) $\psi \longrightarrow 0$, $x^2 + y^2 \longrightarrow \infty$ along any ray in the lower half-plane.

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In (3), f(x) is arbitrary except for an assumed behavior at $x = 0, -\infty$.

This problem is solved by introducing well known complex function techniques. We first assume $f(x) = \delta(x-\alpha)$ and solve for the corresponding ψ. A problem is obtained to solve for a complex function F(z) which satisfies:

(1) F(z) analytic in Im $z < 0$.

(2) $\mathrm{Re}\left\{kF(z) - iF'(z) + \frac{1}{\pi}\cdot\frac{1}{(z-\alpha)^2} - \frac{1}{\pi}\cdot\frac{1}{z^2}\right\} = 0$,

$y = 0,\ x > 0$

(3) $\mathrm{Re}\ F(z) = 0,\ y = 0,\ x < 0$

(4) $F(z) \longrightarrow 0$ as $|z| \longrightarrow \infty$.

Using analytic continuation and assuming

$$F(z) = \int_{p(z)} e^{z\zeta} g(\zeta)\, d\zeta ,$$

we obtain a differential-difference equation for $g(\zeta)$,

$$(\zeta + ik)g(\zeta) + (\zeta - ik)g(\zeta\, e^{2\pi i}) = \frac{2i}{\pi}\,\zeta(e^{-\alpha\zeta} - 1) .$$

This equation is solved in general, the solution taking the form $c_1 g(\zeta) + c_2 g_0(\zeta) g_1(\zeta)$, where $g(\zeta)$ is the general solution of the homogeneous equation, $g_0(\zeta)$ a specific solution of the homogeneous equation, $g_1(\zeta)$ a specific solution of the full non-homogeneous equation.

It is then shown that F(z) satisfies the boundary conditions if c_1 is pure imaginary and $c_2 = 1$. The original function, $\psi(x,y)$, is then easily obtained. We then found that $c_1 = 0$, in order not to have too large a singularity at $z = 0$. In particular we show that:

(1) $\psi \longrightarrow 0$ as $x^2+y^2 \longrightarrow \infty$ along any ray in the lower half-plane (except possibly the negative axis).

(2) $\psi \sim c \log(x^2+y^2) + \mathrm{Re}\,\frac{k}{\sqrt{z}}$ as $x^2+y^2 \longrightarrow 0$, $z = x + iy$

where

$$c = \frac{1}{2\pi}\int_{-\infty}^{0} f(\alpha)\, d\alpha,\ k \text{ constant.}$$

Thus the behavior of ψ at $z = 0$ is seen to depend upon whether $\int_{-\infty}^{0} f(\alpha)\, d\alpha$ is zero or not.

46 pages. $1.00. Mic 56-1805

MUSIC

SYMPHONY NO. I FOR ORCHESTRA

(Publication No. 16,111)

Stanley Gene Finn, Ph.D.
State University of Iowa, 1956

Chairman: Associate Professor Philip Thomas Bezanson

The symphony is in three movements. It utilizes full orchestra including the following instrumentation: piccolo, two flutes, two oboes, English horn, two clarinets, bass clarinet, three bassoons, four horns, three trumpets, three trombones, tuba, timpani, snare drum, suspended cymbals, crash cymbal, and a full complement of strings including violins, violas, cellos, and contrabasses. The emphasis of the work is largely rhythmic, with the textures based upon polyphonic writing contrasted occasionally with homophonic sections.

Each movement was considered to be a part of a larger whole consisting of an overall three-part form strongly contrasted by the movement of fast - slow - fast, a texture of polyphony - homophony - polyphony, and a tonal pattern of "C" - "G" - "C".

The first movement is in sonata-form. The melodic materials for the whole movement are presented in the introduction by the strings. The first theme begins at measure 22 with the allegro. This theme is primarily rhythmic in emphasis and consists of a diminution of the main thematic motive from the introduction. The second theme is an inverted augmentation of the same motive and is introduced by the strings at measure 65. A development section is followed by a recapitulation of the two main themes. This leads to a coda, beginning at measure 138, which combines the ideas of the movement into a climactic conclusion.

The second movement is an A B A form, combining the elements of a slow movement with those of a scherzo. The emphasis of the first section is harmonic and is characterized by lyric woodwind solo passages along with constantly shifting asymmetric rhythms. The middle section presents a contrast through a change of tempo and scherzo-like materials which playfully shift about the orchestra. The original materials return in the third section but are now fully orchestrated. A gradual orchestral thinning down restores the original mood and brings the movement to a quiet close.

The form of the third movement is A B A C A. An introduction, characterized by an alternating 6/8 - 4/8 rhythmic pattern, sets the mood of the movement. A is introduced by the trombones (measure 16) with the rhythmic pattern continuing accompanimentally and now broadening to include occasional measures of 5/8 and 3/4. The A theme is transferred to the horns and then the trumpets which carry it to a climax (measure 38). Following this, the texture quickly thins to the introduction of B (measure 57). The thematic material for B is a rhythmic transformation of the introductory material and is first presented by solo flute. The A theme reemerges (measure 109) now orchestrated in full brass harmony and accompanied by the rhythmic figure in the rest of the orchestra. Antiphonal interchange between the brass and the rest of the orchestra leads to section C of the form. Section C is melodically derived from A and stands in contrast to the preceding sections in the form of a chorale. Beginning with low, dark brass and woodwind color, the chorale section gradually adds brighter color and more harmonic density. This leads to a return of the introductory materials of the movement now orchestrated in high woodwinds and strings. A fugato section based upon A thematic material

brings the work to a climactic coda emphasizing an augmentation of A against the persistent rhythmic figure. The work ends with a final solo reiteration of the rhythmic figure by the timpani. 89 pages. $1.11. Mic 56-1806

MUSIC IN NEW HAMPSHIRE 1623-1800

(Publication No. 16,658)

Louis Pichierri, Ph.D.
Syracuse University, 1956

With the exception of occasional isolated references appearing in general and music histories, New Hampshire has had no recorded comprehensive survey of its early musical development. The writer here presents, in terms of the material itself, an objective picture of musical life in New Hampshire prior to 1800. This study, essentially a source book, is an accumulation of data hitherto unknown or unregarded by other researchers in American music.

The material was derived, chiefly, from primary sources, such as unpublished wills, legal documents, letters, diaries, contemporary newspapers, periodicals and tune books. Secondary sources, especially the works of Oscar G. Sonneck, were utilized for filling gaps and for effecting relationships and perspective. While most of the information was gathered from the New Hampshire Historical Society collections, it was often desirable to use the facilities of other institutions.

New Hampshire's musical development before 1800 clearly indicates her relationship to other communities throughout New England, especially Boston, and to Europe.

References show that during the seventeenth century, the hautboy (oboe), recorder, treble viol, kit, trumpet, drum, virginal, and possibly the lute, were present in the State. In the eighteenth century, moreover, the violin, bass-viol (violincello), German flute, hautboy, clarinet, bassoon, trumpet, French horn, pianoforte, harpsichord, spinet, organ and guitar became familiar objects.

Interest in theatrical entertainments was manifest as early as 1762. Prior to the Revolution, Portsmouth had the opportunity to hear and see exhibitions comprised of songs, dances, instrumental selections and pantomimes, interspersed with readings and recitations. During the 1790s, when Boston was still being restrained by the Massachusetts Anti-Theatre Law of 1750, popular English ballad operas were staged in New Hampshire by traveling theatrical companies.

Public secular concerts were given soon after the Revolution, while a celebration or ceremonial was seldom without appropriate music.

Religious music was largely confined to congregational singing until about 1750, although a psalm by a choir, or by a special group able to sing according to the "approved rule," was not unknown before 1661. The eighteenth century witnessed a country-wide movement to improve church music. In New Hampshire, as elsewhere, singing schools and singing societies were established. As a result, church choirs began to flourish, musical instruments were introduced into the service, and sacred concerts became a part of community life.

Newspaper advertisements indicate that lessons in vocal and instrumental music, as well as in dancing, was offered as early as 1665, by a few skilled musicians from England and France, and a number of native itinerant psalmodists, some of whom had achieved a certain facility as instrumentalists. With the rise of the academies in the early 1780s, music became a regular part of their curricula, the instruction given by the itinerants.

In the area of music publishing, Henry Ranlet of Exeter, New Hampshire, was one of the earliest printers in the country to own music-type. Many tune books, notably the Village Harmony, issued from his "Music Press," saw widespread use in New England.

Finally, some of the personalities who made significant contributions to New Hampshire's musical development, during its formative period, include: William S. Morgan, teacher, conductor, composer and performer; Horatio Garnet, teacher, conductor, composer and performer; Dr. John L. Berkenhead, teacher, performer and composer; Benjamin Dearborn, teacher and inventor of a music reading method; Ichabod Johnson, teacher and conductor; Samuel Holyoke, compiler and composer; Asa McFarland, teacher; Richard Merrill, composer; and John Hubbard, teacher, compiler, composer and conductor.

373 pages. $4.66. Mic 56-1807

PHARMACOLOGY

AN ELECTRONIC INSTRUMENT FOR RECORDING BLOOD PRESSURE AND ITS APPLICATION TO PHARMACOLOGY

(Publication No. 16,366)

Stewart Walter Freyburger, Ph.D.
The University of Florida, 1956

The nature of arterial pressure and factors which cause it to vary are reviewed. A brief history of the development of instruments for the measurement of blood pressure is presented. The problems and errors of indirect determination are explained with the advantages of eliminating the great variable of the subjectivity of the examiner.

A new instrument for the automatic indication of blood pressure is presented along with an explanation of its mechanism and the theory of its application.

Experiments are performed in which the new instrument is compared to the method of auscultation. Determinations are made on male and female college students as well as a non-select group under various conditions. The value of the instrument in physiological and pharmacological studies is demonstrated by blood pressure

determinations made with test subjects in various positions, following exercise, during sleep, and upon the administration of depressor drugs.

The instrument is compared with direct blood pressure measurement in the dog. Experiments were performed with the animal under light anesthesia, deep surgical anesthesia, and with the trained, unanesthetized dog. Several drugs were injected which markedly altered the blood pressure and finally the ability of the instrument to indicate blood pressure in shock due to hemorrhage was determined.

The results of the experiments are discussed and it is concluded that the new instrument is as accurate as any indirect method and has several advantages over the commonly used instruments and methods.

119 pages. $1.49. Mic 56-1808

THE PHARMACOLOGY OF MESCALINE

(Publication No. 13,773)

Louise Barrett Speck, Ph.D.
University of Colorado, 1955

Supervisor: Professor Richard W. Whitehead

Mescaline, one of the alkaloids found in the peyote cactus, produces colored visions, synesthesias, and alterations of the functioning of the nervous system in human beings. The symptoms of mescaline intoxication have been compared to the symptoms of certain behavior disorders. Investigation of its mode of action seemed worthwhile because its structural formula is similar to epinephrine.

A summary of the results is listed as follows:

1. The intraperitoneal LD50 of mescaline sulfate for nonfasted, male, albino rats was found to be 37 mgm/100 gm body weight with upper and lower confidence limits of 41.0 and 33.2 mgm/100 gm for 19/20 probability.

2. The effects of increasing doses of mescaline did not follow the usual logarithmic dose-effect relationship; ie., maximal heart slowing was found at an intermediate dose. Death was accompanied by flexor convulsions and respiratory arrest.

3. Electroencephalographic investigations indicated that mescaline had an effect similar to epinephrine on cerebral activity. The EEG records became predominantly fast. At intermediate doses bursts of spikes were frequently seen which were not accompanied by muscular activity.

4. Insulin greatly increased the toxicity of mescaline. Epinephrine had a protective effect against the heart slowing and hypoglycemic effects of mescaline but had no influence on the lethality.

5. The effect of various drugs on mescaline action was investigated. Atropine partially prevented the heart slowing in unanesthetized animals but not in the anesthetized animal. Mescaline has an analeptic action against the usual anesthetic dose of pentobarbital, but proved to be too toxic in combination with larger doses of pentobarbital to be useful therapeutically. Decamethonium and curare did not prevent the terminal flexor convulsions in any dose that did not cause death. Phentolamine methane sulfonate modified the terminal convulsions to a clonic type without effect on the lethality. The toxicity of mescaline was increased when it was administered along with physostigmine. Spike activity due to physostigmine and mescaline was not increased when the two drugs were given together.

6. The threshold to electroshock was slightly elevated in confirmation of Tainter's results. Only cocaine and mescaline had this effect among the many central stimulants investigated by Tainter.

7. Some preliminary investigation into the electrolyte effects was attempted. The results were inconclusive due to excessive hemolysis of the samples.

8. An experiment in which a group of rats received daily mescaline injections of 5 mgm/100 gm for a month and a half suggested that mescaline had a general "stressing" effect. No damage to heart, kidney, or brain was observed either grossly or microscopically. Fatty infiltration of the liver was seen microscopically. The adrenals had increased in weight due to marked hyperplasia of the adrenal cortex. The EEG record and heart rate were fast, and moderate hyperglycemia was present at the end of the experiment before the daily injection, whereas the typical heart slowing and hypoglycemic effect appeared after the daily dose of mescaline had been given. However, the EEG record became slower after mescaline in contrast to the results found in the acute experiments.

It was concluded that mescaline has both peripheral and central effects. It has been suggested that mescaline can compete for epinephrine receptors. There is no indication that mescaline is found in significant concentrations in the brain. Therefore, the central effects may be due to increased circulating epinephrine rather than mescaline itself. The arousal pattern of the EEG, analeptic effect, flexor convulsions, and temporal and occipital lobe disfunction suggest a specific stimulatory effect on the reticular formation and its projections in contradistinction to simple release of the brain stem resulting from inhibition of cortical synapses. Acetylcholine mechanisms may be involved. Mescaline should be useful as a research tool in the investigation of the functioning of the nervous system and of certain behavior disorders.

83 pages. $1.04. Mic 56-1809

BEYOND PARMENIDES: THE PROBLEM OF NON-BEING. AN ONTOLOGICAL ESSAY DEVELOPING SOME IMPLICATIONS OF PLATO'S DISTINCTION BETWEEN ABSOLUTE AND RELATIVE NON-BEING.

(Publication No. 16,655)

Thomas Stanley Knight, Ph.D.
Syracuse University, 1956

Although Plato is considered to be the greatest dualist of all time, in his later dialogues, particularly in the Parmenides and the Sophist, he waged a war against Parmenides' being/non-being dichotomy. The Parmenidean separation of those two terms was found to be untenable in ontology. An ontological rationalization of experience seemed to depend on relative being and non-being; the consideration of those two fundamental ontological notions as absolute left the phenomenal world in the realm of unreality. Plato's attempted demonstration of a relation between being and non-being stands at once as a formulation of the principal ontological problem and as doctrine emphasizing the impossibility for ontology of a separation of "what is" and "what is not." If ontology was to go beyond the native monism of the Eleatics, then "what is" had to have an intelligible opposite.

An analysis of Parmenides reveals that he was not concerned with the problem of the void, nor did his statement "non-being is not" deny the possibility of making negative statements. Parmenides' denial was neither logical nor cosmological; his "non-being is not" denied an ontological opposite to the One Being. Such a denial involved taking Being and Non-being in the absolute sense so as to prohibit their combination or relation. The result of such an assumption for ontology is effectively criticized by Plato in Part II of the Parmenides.

There the absolute Being of Parmenides is shown to be beyond articulation, an empty concept about which nothing positive can be said. Non-being, from the Parmenidean point of view, is seen to be equally unintelligible. Therefore, implied Plato, if Being and Non-being are to be ontological terms, then they must be less than absolute, one and many, and they must combine or in some sense overlap each other. In a word, they must be relative. And their relation is carefully argued in the Sophist. This distinction between absolute and relative non-being throws light on some recent problems which, when considered from Plato's point of view, are seen to be irrelevant to ontology. I refer to the problem of "ontological commitment" and the so-called "Ontological Question."

The implications of Plato's analysis of non-being are very important for ontology. Ontology investigates "what is"; other systems of inquiry assume aspects of "what is" as their subject matters without questioning the being of the subject assumed. Plato's relation of "what is" and "what is not" seems to force the ontologist into holding differences in degree and kind of being. Those who do not wish to hold these distinctions are committed to an arbitrary separation of "what is" and "what is not" and an implied definition of entity more rigid than that of Plato. When logicians devise means of denying the being of a supposed entity, they are arguing on a logical vis-a-vis an ontological level. The question of what ontology my system of discourse commits me to is a logical as opposed to an ontological question. The indispensable being/non-being relation involves ontologists in the admission of every possible notion between the absolute extremes of inquiry as entities. The ontologist is committed to every conceivable kind of being.

Furthermore, attempts, on the part of ontologists, to think "what is" and "what is not" in absolute separation has led them to consider the question "why is there something; why not nothing?" as ontological, when in fact it is a question that falls outside ontological discourse. Plato's great lesson concerning opposition applies not only to terms but also to questions in ontology.

138 pages. $1.73. Mic 56-1810

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

PHYSICS, GENERAL

THE MICROWAVE SPECTRA OF InCl, InBr, InI AND GaCl

(Publication No. 16,270)

Alan Hildreth Barrett, Ph.D.
Columbia University, 1956

The rotational spectra of InCl, InBr, InI and GaCl have been observed with the Columbia high-temperature spectrometer. The data is analyzed in terms of molecular constants. The values obtained are:

Molecule	B_e(Mc/sec)	α_e(Mc/sec)	eqQ (Mc/sec)	
$In^{115}Cl^{35}$	3,269.47±0.14	15.34±0.14	-655±6	In^{115}
			-18±2	Cl^{35}
$In^{115}Br^{79}$	1,670.141±0.020	5.706±0.010	-642±12	In^{115}
			138±11	Br^{79}
$In^{115}I^{127}$	1,104.95±0.45	3.117±0.015		
$Ga^{69}Cl^{135}$	4,493.73±0.19	23.27±0.12	-84.7±1.0	Ga^{69}
			-20±-2	Cl^{35}

Molecule	r_e (A.)
$In^{115}Cl^{35}$	2.4011±.0001
$In^{115}Br^{79}$	2.5432±0.0001
$In^{115}I^{127}$	2.7539±0.0009
$Ga^{69}Cl^{135}$	2.2017±0.0001

An interpretation of the quadrupole coupling constants with regard to the molecular bond is given and evidence of s-p hybridization is discussed.

55 pages. $1.00. Mic 56-1811

THE MEAN LIFE OF THE $^3P_2$ METASTABLE ARGON LEVEL

(Publication No. 16,637)

Archer Hamner Futch, Jr., Ph.D.
University of Maryland, 1956

Supervisor: Professor Frank A. Grant

An optical absorption method was used to measure the population of the $^3P_2$ metastable level of argon. Radiation from an emission tube was focused through an absorption tube on to the slit of a monochromator which separated the argon spectrum so that only the radiation from one spectral line fell upon the cathode of a photomultiplier tube. After detection by the photomultiplier tube, the signal was displayed on an oscilloscope. The gas in both the emission tube and the absorption tube was excited by rectangular pulses from multivibrator circuits, synchronized with an audio oscillator. By observing the intensity of the photomultiplier signal at different times after the excitation of the gas in the absorption tube, the decay of the metastable level was calculated.

The conventional treatment of the theory of absorption is given where it is assumed that both absorption and emission lines have shapes determined by Doppler broadening. The effect of pressure broadening on the theory of absorption is discussed.

A diffusion equation for the decay of metastable atoms in the late afterglow of a pulsed discharge is solved with more general boundary conditions imposed at the cylindrical walls which apply when the mean free path is not negligible compared to tube dimensions. The effect of imprisonment of radiation and a differential equation for the metastable decay which takes into consideration the exchange of energy between the $^3P_1$ and the $^3P_2$ levels of argon are discussed. The effect of forbidden radiation and the natural lifetime of a metastable state are also investigated.

Measurements of the mean life of the $^3P_2$ metastable state were made as a function of pressure for room temperature and at 77° Kelvin. The results of measurements made using a tube of small diameter at room temperature show that the customary boundary conditions do not give good agreement with experimental data at low pressures. Agreement with experimental data was obtained by the use of the more general boundary conditions. Measurements of the $^3P_2$ decay curves as a function of current show the destruction of metastable atoms by high energy electrons or ions to be an important process at 300° Kelvin.

An initial increase in the density of the $^3P_2$ state immediately after the absorption tube pulse was observed to occur at high pressures. Therefore, the decay curve for the $^3P_2$ state exhibited a maximum, which occurred at approximately 0.7 milliseconds for a pressure of 5 mm Hg.

Comparison of the data at 300° Kelvin with that at 77° Kelvin shows that the two-body collision coefficient becomes smaller at lower temperatures while the three-body collision coefficient appears to become larger. The temperature dependence of the diffusion coefficient at constant density disagreed with the $\sqrt{T}$ dependence expected from simple kinetic theory.

Curves of the mean life of the $^3P_2$ state versus pressure have also been obtained for various mixtures of argon and neon. The three-body collision term disappears, and the two-body collision term becomes smaller as the argon to neon ratio decreases.

157 pages. $1.96. Mic 56-1812

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

THE INTERACTION OF A SHOCK WAVE AND A PLANE GASEOUS INTERFACE AT GRAZING INCIDENCE

(Publication No. 16,717)

Donald Charles Hock, Ph.D.
The Pennsylvania State University, 1956

An attempt to investigate the retransmitted region which occurs in anomalous shock wave refraction at a plane gaseous interface has been made. There is no existing theory to describe this type of interaction.

The interaction was attained by dividing the shock tube test section into two chambers by means of collodion films which spanned Phosphor-Bronze frames. The frames were inserted into slots in the walls of the test section so that no metal, except a thin horizontal strut, appeared in the air stream. After the air was replaced in one chamber by a test gas, a $\xi = 0.60$ incident shock transmitted a shock into each chamber. The difference in transmitted shock strengths and sound speeds in the two chambers caused two transmitted shocks to become detached and consequently form a retransmitted disturbance. The test gases used were freon-12, carbon dioxide, methane, helium, hydrogen and mixtures of these gases with air.

Shock strengths were measured using a Mach-Zehnder Optical Interferometer. The test gas compositions differed in each picture and were monitored by comparing the velocity of the shock transmitted into the test gas to the velocity of a $\xi = 0.60$ shock in air. Pressure-Particle Velocity diagrams[1] for the gas mixtures were relied upon to disclose the gas mixture composition as well as the pressure behind the transmitted shock. Grazing incidence was chosen since it afforded the greatest shock separation and is a limiting case for the more general problem of irregular shock wave refraction.

The retransmitted wave was studied for some different fast gas layer depths. The retransmitted angle was compared to the angle expected when both the transmitted and retransmitted shocks have equal strengths. Good agreement is obtained for the larger shock separations in helium-air, hydrogen-air, and air-freon-12 gas combinations.

The air-carbon dioxide and the methane-air gas combinations produce angles about 8° below those anticipated. The depth of the fast gas layer had no strong effect on the retransmitted angle.

The retransmitted angle can, to a good approximation, be predicted by treating the configuration the same as supersonic flow around a wedge or corner in a wind tunnel.

Retransmitted wave strengths were measured for the helium-air and the hydrogen-air gas combinations. In the case of these two combinations, the 1/4″ test gas layer produced a retransmitted region displaying two compressional waves. The 1/2″ test gas layer also produced two waves, but in this case, the first wave was a shock. The 1″ helium mixture layer produced the strongest retransmitted shock.

The retransmitted region was characterized by a compression wave or a shock front followed by a pressure gradient. The interaction of this region with a step shock followed by a rarefaction produced the usual Mach configuration with an added inverted "V" pressure wave following one of the reflected stems. 62 pages. $1.00. Mic 56-1813

1. Supersonic Flow and Shock Waves, Interscience Publishers, (1948).

VITA

Donald Charles Hock was born on April 18, 1929 in North Tonawanda, New York. He was graduated from the North Tonawanda High School in 1947, and entered the University of Buffalo the same year.

He received the B.A. degree in Physics from the University of Buffalo in June, 1951, an M.S. degree in Physics from the Agricultural and Mechanical College of Texas in August, 1952, and the Ph.D. in Physics from The Pennsylvania State University in January 1956.

He served as a Graduate Assistant at the A. & M. College of Texas. At The Pennsylvania State University, he was a Graduate Assistant from September 1952 to June 1953 and from February 1954 to June 1954. He served as a Research Fellow in the Shock Wave Laboratory from September 1953 to January 1954 and from September 1954 to September 1955.

He is a member of Phi Kappa Phi, Sigma Pi Sigma, Pi Mu Epsilon, and an Associate Member of Sigma Xi.

AN ANALYSIS OF THE NOISE SPECTRUM DUE TO CAVITATION PRODUCED BY ACOUSTIC FIELDS

(Publication No. 16,718)

William Holak, Ph.D.
The Pennsylvania State University, 1956

Cavitation acoustic fields were generated by several transducers at 9 kc, 210 kc, 440 kc, 800 kc, and 1080 kc. Barium titanate discs, a focusing barium titanate bowl and a magnetostrictive vibrator were used to generate these acoustic fields in liquid volumes of different size and shape. Focusing systems were employed except at 9 kc. Measurements were made in both the ORL anechoic tank and in the Physics Acoustic Laboratory tank.

The noise due to cavitation thus produced has been analyzed over a continuous frequency range from 90 cps to 2 mc. The receiving hydrophones employed were a calibrated Massa 115 A and an Allen-Spencer probe microphone. The latter was calibrated by the Ordnance Research Laboratory of The Pennsylvania State University from 1 kc to 120 kc and by a pulse reciprocity system in the Physics Acoustic Laboratory from 100 kc to 2 mc. The A-S probe microphone proved to be practical as a detector for the cavitation noise study. It was possible to make measurements with it conveniently in small liquid volumes as in the 800 kc bowl and the 9-kc Raytheon vibrator. Three different analyzers were used to cover the entire frequency range.

From the investigation of the noise spectrum, harmonics as well as the subharmonic of the exciting frequency have been observed in addition to the broad-band noise. The broad-band noise exhibits two plateaus and the curve between them has a slope of -6 db per octave. The shape of the noise spectrum due to ultrasonically generated cavitation has been found to be independent of the geometry and size of the liquid volumes in which acoustics fields were produced. More energy appeared at the driving frequency and its harmonics than in the broad-band spectrum.

An expression for the pressures emitted by cavitating bubbles has been developed which is in accord with experimental results. The bubbles were considered to grow according to the rectified diffusion theory and then collapse.

The breaking points on the noise spectrum curves were observed experimentally to shift towards higher frequencies as the exciting frequency to produce cavitation was increased. The breaking point is defined to be that part of the curve where its slope is changing. It was possible to account for this observed shift in the equation developed for the pressure distribution using the results from the theoretical investigation on cavitation by Noltingk and Neppiras.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

It would be desirable to continue this noise study of cavitation produced by acoustic fields. It would be worthwhile to extend this study to 90 cps at driving frequencies other than 210 kc to produce cavitation in order to determine the dependence of the length of low frequency plateau on the driving frequency and above 2 mc to determine the length of the upper plateau. 90 pages. $1.13. Mic 56-1814

VITA

William Holak was born on September 13, 1929, in Edwardsville, Pennsylvania, and was graduated from Edwardsville High School in 1947. He attended Wilkes College in Wilkes-Barre, Pennsylvania, for three semesters and then transferred to The Pennsylvania State University where he received his B. S. degree in 1951, his M. S. degree in 1953, and his PhD degree in 1956. He is a member of Alpha Nu, Sigma Pi Sigma, and Sigma Xi. During part of his graduate work, he held the title of graduate assistant. Also, he was the recipient of an Ordnance Research Laboratory fellowship.

THE INTERFEROMETRIC ABSORPTION SPECTRUM OF TlCl

(Publication No. 16,176)

Robert Rudstone Kadesch, Ph.D.
The University of Wisconsin, 1956

Supervisor: Associate Professor J.G. Winans

The absorption spectrum of TlCl was photographed with an absorbing path of eight meters using a Fabry-Perot interferometer. A double-pass Wadsworth mounting employing a 21 foot concave grating was used as the cross-dispersion. The resultant patterns obtained as a result of the superposition of the white light Fabry-Perot fringes and the rotational fine structure shall be termed "moiré spectra." Wavenumbers for rotational lines were determined to an accuracy of ± 0.01 cm.$^{-1}$, and for band heads to an accuracy of ± 0.1 cm.$^{-1}$.

A rotational analysis of the 0,0, 1,1, and 1,0 bands gave $B_e'' = 927.3 \times 10^{-4}$ cm.$^{-1}$, $B_e' = 937.8 \times 10^{-4}$ cm.$^{-1}$, $D'' = 13.61 \times 10^{-8}$ cm.$^{-1}$, $D' = 18.12 \times 10^{-8}$ cm.$^{-1}$, $\alpha_e'' = 2.48 \times 10^{-4}$ cm.$^{-1}$, $\alpha_e' = 14.47 \times 10^{-4}$ cm.$^{-1}$, $r_e'' = 2.466 \times 10^{-8}$ cm., and $r_e' = 2.452 \times 10^{-8}$ cm. Band origins calculated from the observed wavenumbers of the band heads by use of the rotational constants are given by

$$\mu_0 = 31{,}053.78 + 209.78\,(v' + \tfrac{1}{2}) - 3.41\,(v' + \tfrac{1}{2})^2$$
$$-0.36\,(v' + \tfrac{1}{2})^3 - [284.850\,(v'' + \tfrac{1}{2}) - 0.847\,(v'' + \tfrac{1}{2})^2] \quad .$$

The isotope shift for the four isotopic combinations

$$Tl^{205}Cl^{35},\ Tl^{205}Cl^{37},\ Tl^{203}Cl^{35},\ \text{and}\ Tl^{203}Cl^{37}$$

was calculated using the rotational and vibrational constants. The mean deviation from the observed shifts was 0.2 cm.$^{-1}$ for 111 observations.

The value of B_e'' obtained here differed from the value $874.0 \pm 0.8 \times 10^{-4}$ cm.$^{-1}$ determined from a molecular beam electric resonance method. The difference is 60 times the probable error which is approximately the same for both experiments. The plots of $\frac{\Delta_2 F(J)}{J + \frac{1}{2}}$ vs. $(J + \frac{1}{2})^2$ deviated from a straight line at low J as found previously for InCl and GaCl. No explanation for the deviation has been found.

The dissociation energy has been fixed as 3.902 ± .005 e.v. This is consistent with the presently accepted value 3.78 ± 0.1 e.v. determined by atomic fluorescence and thermochemical data. 79 pages. $1.00. Mic 56-1815

OSCILLATOR STRENGTHS FOR TRANSITIONS BETWEEN $2p^3 3p$ AND $2p^3 3s$ IN OXYGEN I, INCLUDING CONFIGURATION INTERACTION

(Publication No. 16,333)

Robert F. Kingsbury, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor C. W. Ufford

The purpose of this work was to calculate oscillator strengths for transitions between the terms of the configurations $2p^3 3p$ and $2p^3 3s$ in oxygen I. Since configuration interaction is expected to be large, it was taken into account in the determinations of the wave functions for the various states. The configurations $2p^3 4s$ and $2s2p^5$ were included with $2p^3 3s$, while $2p^3 4p$ was included with $2p^3 3p$.

Wave functions for the various states were determined and the matrix elements of electrostatic interaction were calculated in terms of Slater radial integral parameters. The energy matrix was diagonalized and the parameters were evaluated by fitting calculated to experimental term values using a series of least squares calculations. In order to get a good fit, the L(L+1) correction of Trees was needed. It was shown that the L value for this correction should be that of the parent ion.

Hartree radial wave functions without exchange were calculated for the electrons involved. Values of σ^2 were calculated using the dipole velocity form for σ and the Hartree wave functions. These values of σ^2 were compared with values determined by the method of Bates and Damgaard.

Oscillator strengths are tabulated as are the Hartree wave functions used. 88 pages. $1.10. Mic 56-1816

LIQUID HELIUM FILM STUDIES

(Publication No. 16,285)

Leonard Lesensky, Ph.D.
Columbia University, 1956

Part I: The Temperature Dependence of the Transfer Rate of the Helium II Film

The present investigation was concerned with the measurement of the temperature dependence of the transfer rate of the liquid helium II film at temperatures below 1°K; these low temperatures being achieved by the adiabatic demagnetization of gadolinium sulfate and of iron ammonium alum. An electronic technique, developed in this laboratory,[1] for measuring the transfer rate of the film used a cylindrical capacitor as the transfer vessel and required a calibration based on visual observation of the helium level in the apparatus. This technique was modified[2] so that the rate could be directly determined from the elapsed time required for the liquid level in the annulus of the capacitor transfer vessel to move from one identifiable to another.

The transfer rate data for a clean machined copper surface in the temperature range from the lambda point down to 0.8°K agreed approximately with that of Dash and Boorse[3] down to 1.2°K and served as an extension thereof. The rate appeared to remain constant down to 0.8°K. Transfer rate data for a contaminated copper surface showed a definite rise in the value of the transfer rate as the temperature was decreased below 1.1°K and down to 0.75°K, the lowest temperature at which data was taken. The contamination is believed to have been due to conden-

sation of water vapor from the hydrated salts. It is speculated that the rise in the value of the transfer rate of the helium II film at temperatures below 1°K is connected with the increasing significance of phonons in this region.

Part II: The Height Dependence of the Transfer Rate of the Helium II Film

The present investigation endeavored to determine whether, apart from a rim effect of uncertain magnitude, the transfer rate is independent of the height, h, through which the film climbs and whether the difference in height, ΔH, of the two liquid levels connected by the film affects the rate. Both these investigations were carried out for distances considerably larger than those previously reported. An electronic method described in Part I was used to measure the transfer rate of the film on a brass surface. The measurements of the transfer rate as a function of h and of ΔH were carried out at the lowest convenient temperature, (1.35°K), since rate measurements in this region are not appreciably affected by small changes in temperature.

In the region near the rim ($h < 5$ cm), the rate was a monotonically decreasing function of h; whereas from $h = 5$ cm to $h = 18.7$ cm, the rate was constant at a value of 11.8×10^{-5} $(cm^3/sec)/cm$ to within 7%. The transfer rate was found to be independent of ΔH both when the upper level was near or far from the rim. The maximum variation of R as ΔH varied from 1.2 cm to 21.4 cm was estimated to be 5%.

The fact that the flow rate is independent of ΔH and of path length means that gravitational and ordinary frictional forces play an insignificant role in determining the rate of flow. The extension of these measurements to larger values of h and of ΔH had the effect of setting a lower upper limit to the part played by these forces in the film flow phenomenon. 52 pages. $1.00. Mic 56-1817

1. J. G. Dash and H. A. Boorse, Phys. Rev. 82, 851 (1951).

2. L. Lesensky and H. A. Boorse, Phys. Rev. 87, 1135 (1952).

3. J. G. Dash and H. A. Boorse, ibid.

THE DESIGN AND APPLICATION OF A WEISSENBERG X-RAY CAMERA FOR STUDIES NEAR LIQUID HELIUM TEMPERATURE

(Publication No. 16,725)

Arthur Stephen Pavlovic, Ph.D.
The Pennsylvania State University, 1956

The design of a low temperature x-ray goniometer for use between the temperatures of liquid helium (4.2°K) and liquid nitrogen (77°K) is presented. It can be used to obtain powder, oscillation or Weissenberg photographs. The liquid helium dewar, which is surrounded by surfaces at the temperature of liquid nitrogen, has a goniometer head soldered to its lower end. The crystal, which is mounted at the tip of the goniometer head and protrudes into the vacuum jacket of the dewar, is cooled by conduction and is irradiated with x-rays through a polystyrene enclosure at the lower end of the dewar.

The translation motion of the camera and rotation of the dewar are coupled by a gear and screw arrangement which is driven by a 40 rpm reversing motor; each can be disengaged from the system to allow for independent operation.

A General Electric CA-7 x-ray tube, mounted horizontally, supplies the x-ray beam.

A powder pattern of potassium tantalate has been obtained at 6°K; and single-crystal diagrams of α-quartz have been taken at 80°K and 10°K.

57 pages. $1.00. Mic 56-1818

VITA

Arthur Stephen Pavlovic was born on December 2, 1925 in Bedford, Ohio. He received his elementary and secondary education in the public schools of Cleveland and Maple Heights, Ohio, graduating from Maple Heights High School in 1943. From 1943 to 1946 he was a U. S. Navy V-12 student at Yale University, from where he received a B. E. degree in Electrical Engineering. In 1947 he matriculated at Case Institute of Technology, receiving an M. S. degree in Physics. He became a graduate student in physics at Columbia University in 1949, and then transferred to The Pennsylvania State University in 1952. He received a Ph. D. in Physics in 1956.

ATOMIC MASSES OF THE ISOTOPES OF IRON, COBALT, NICKEL, COPPER, AND ZINC

(Publication No. 16,563)

Karl Spangler Quisenberry, Jr., Ph.D.
University of Minnesota, 1956

A large double-focusing mass spectrometer has been developed for the precise determination of atomic mass relative to O^{16} by the doublet method. Based upon the design used at this laboratory for the successful, smaller, double-focusing mass spectrometer, this instrument embodies certain improvements. Resolving power ranges from 30,000 to 75,000 with about 40,000 being used for most measurements. The actual measurement of doublet mass differences is facilitated by use of the peak matching method. This method utilizes an oscilloscopic display of the ions peaks corresponding to the doublet members and converts the measurement into a task of causing two displayed peaks to appear superimposed. Considerable effort has been devoted to the control and elimination of all known sources of systematic error. Consistency tests performed suggest this goal has been achieved to the extent that doublet measurements are correct (excluding statistical uncertainty) to at least 1 in 25,000.

A set of mass doublets sufficient to calculate the masses of all the stable isotopes of iron, cobalt, nickel, copper, and zinc has been measured. The resulting mass values appear to be correct to at least 1/8,000,000. When compared with the masses obtained by the previous systematic investigation, the present results agree favorably in all cases except that of nickel.

Accuracy of the data may be further tested by comparing the measured mass differences between neighboring isotopes with the same results calculated using nuclear reaction and β-decay energy data. In general, the pattern of agreement is remarkably good but several discrepancies appear, suggesting topics for further investigation.

With the measured stable isotopic masses as a base, the nuclear energy data were used to calculate mass values for all unstable isotopes of these elements. The complete mass table so obtained has been used to study nuclear interaction energies, that is, the binding energies associated with individual nucleons. The binding energies for both the last proton and the last neutron in the nucleus were calculated for all nuclei where sufficient data exists. Variations in these binding energies exhibit regularities which may be discussed in terms of variations in the neutron-proton ratio of the nuclei involved.

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Nucleon pairing energy was also calculated wherever possible for the last pair of like neutrons, both proton and neutron, in these nuclei. An attempt to correlate the magnitude of this pairing energy with the relative magnitude of the angular momentum associated with the pair's nucleon energy level ended in only partial success. Apparently other factors of nuclear structure influence the strength of the pairing interaction.

109 pages. $1.36. Mic 56-1819

THE ATOMIC MASSES OF THE STABLE ISOTOPES OF BORON, CARBON, NITROGEN, OXYGEN, FLUORINE, NEON, SODIUM, MAGNESIUM, ALUMINUM AND SILICON

(Publication No. 16,565)

Theodore Thomas Scolman, Ph.D.
University of Minnesota, 1956

The 16-inch double-focusing mass spectrometer recently constructed at Minnesota has been used to measure the masses of all stable isotopes in the range $10 \leq A \leq 30$. The mass values are: $B^{10} = 10.016127 \pm 4$ a.m.u.; $B^{11} = 11.012810 \pm 7$; $C^{12} = 12.0038169 \pm 8$; $C^{13} = 13.0074929 \pm 9$; $N^{14} = 14.0075264 \pm 8$; $N^{15} = 15.0048793 \pm 4$; $O^{17} = 17.0045364 \pm 5$; $O^{18} = 18.0048843 \pm 8$; $F^{19} = 19.0044429 \pm 20$; $Ne^{20} = 19.9987952 \pm 15$; $Ne^{21} = 21.0005208 \pm 12$; $Ne^{22} = 21.9983778 \pm 7$; $Na^{23} = 22.9970914 \pm 21$; $Mg^{24} = 23.9926717 \pm 16$; $Mg^{25} = 24.9937835 \pm 15$; $Mg^{26} = 25.9908544 \pm 14$; $Al^{27} = 26.9901113 \pm 25$; $Si^{28} = 27.985821 \pm 8$; $Si^{29} = 28.985701 \pm 10$; $Si^{30} = 29.983289 \pm 7$.

No serious discrepancies were found between the present work and the results of other mass spectroscopic investigations except at Ne^{20}. The excellent agreement with the very precise mass synchrometric measurements of Smith is particularly gratifying. The excellence of the data on Ne^{20} supports the conjecture that the present value is essentially correct.

The masses calculated from nuclear reaction energies are, with the exception of F^{19}, lower than the present mass spectrometric results. Three Q-values which are inconsistent with other Q-values and also with the mass spectrometric results were eliminated from the nuclear reaction data and the Q-value masses recalculated. The new values are in much better agreement with the mass spectrometric results but are still, with the exception of F^{19}, lower than the present mass spectrometric results.

The agreement between the two systems of masses is not improved by changing the mass spectrometric secondary standard C^{12} to agree with the Q-value result or by a percentage change in all mass doublet values. Neither is the agreement improved by a change in either the calibration of the nuclear spectrometers or a change in the mass-energy conversion factor.

There seems to be no simple or obvious way to reconcile the two systems of masses, but further careful measurements, both of mass spectroscopic doublets and nuclear reaction energies, may improve the agreement.

77 pages. $1.00. Mic 56-1820

THE PRODUCTION OF A CHARGED MESON BY A NUCLEON OR AN ELECTRON (PARTS I AND II)

(Publication No. 15,408)

Ellis Strick, Ph.D.
Purdue University, 1950

Major Professor: Dr. F. J. Belinfante

The cross-section for the production of a charged scalar meson in a nucleon-nucleon collision was considered first. A discrepancy in the resulting cross-section as determined by two different methods, the perturbation and impact parameter methods, was removed. The new result for the perturbation treatment was found to be

$$\sigma_s^n = \frac{\pi}{8}\left(\frac{g^2}{\hbar c}\right)^3 \frac{\hbar c}{\mu}\,\frac{\hbar c}{E_0}$$

which is in good agreement with

$$\sigma_s^n = 2a\left(\frac{g^2}{\hbar c}\right)^3 \frac{\hbar c}{\mu}\,\frac{\hbar c}{E_0}$$

which was reported by Wang, who used the impact parameter treatment. Here μ is the mass of the meson in energy units, $E_0 \gtrsim 60{,}000$ Mev. and $a \sim 1$.

Using the same perturbation formalism, the cross-section for the production of a charged pseudoscalar meson (pseudovector coupling) in a high energy nucleon-nucleon collision was shown to be

$$\sigma_{ps}^n \sim \frac{a}{3}\left(\frac{g^2}{\hbar c}\right)^3 \left(\frac{\hbar c}{M}\right)^2 \left(\frac{E_0}{\mu}\right)^6$$

where again a is a constant of the order of magnitude 1.

Next, the cross-section for the production of a charged scalar meson by a high energy electron interacting with a proton was considered. Both perturbation and impact parameter treatments were employed and the resulting cross-sections were shown to be respectively

$$\sigma_s^{el} = \frac{4}{3}\frac{g^2}{\hbar c}\left(\frac{e^2}{\mu}\right)^2 \log\frac{\epsilon_0}{m},$$

$$\sigma_s^{el} \simeq \frac{5}{6}\frac{g^2}{\hbar c}\left(\frac{e^2}{\mu}\right)^2 \frac{M}{\mu}\log\frac{\epsilon_0}{m}.$$

Here ϵ_0 is the energy of the incident electron and the target proton is assumed to be at rest.

The same cross-section was also evaluated at threshold energies and found to be

$$\sigma_s^{el} = \frac{4}{3}\frac{g^2}{\hbar c}\left(\frac{e^2}{\mu}\right)^2 \left[1 - \left(\frac{\mu}{\epsilon_0 - m}\right)^2\right]^{3/2} \left(\log\frac{\epsilon_0}{m} - 1\right).$$

Thus, for energies just above threshold we have

$$\sigma_x^{el} \sim (\Delta\epsilon)^{3/2}$$

where $\Delta\epsilon \equiv \frac{\epsilon_0 - \epsilon_{th}}{\epsilon + b}$ with ϵ_{th} designating the threshold energy.

Using the same perturbation formalism as was developed for the production of a charged scalar meson by an electron, and making some questionable approximations, the

cross-section for the production of a charged pseudoscalar meson was shown to be

$$\sigma_{ps}^{el} \simeq \frac{1}{9}\left(\frac{1}{2}\frac{\mu^2}{M^2}\frac{f_1^2}{\hbar c} + \frac{f_2^2}{\hbar c}\right)\left(\frac{e^2}{\mu}\right)^2 \left[1 - \left(\frac{\mu}{\epsilon_0 - m}\right)^2\right]^{3/2} \left(\log \frac{\epsilon_0}{m} - 1\right),$$

which has the same energy dependence as for the production of a scalar meson but has a slightly smaller numerical value.

In all of the above calculations the effect of field reactions was neglected. 85 pages. $1.06. Mic 56-1821

THE PHOTO-DISINTEGRATION OF THE DEUTERON

(Publication No. 15,411)

Chia Hsien Teng, Ph.D.
Purdue University, 1950

Major Professor: Dr. F. J. Belinfante

We have calculated the cross-section for photodisintegration of the deuteron by a high energy photon. The interaction between the photon and the nucleons was expressed as

$$W = -\int \vec{I}\cdot\vec{A}\, d^3\vec{x} = -\int \rho\, \vec{\xi}\, \frac{\vec{E}(\vec{\xi}) + \vec{E}(O)}{2}\, d^3\vec{x}$$

$$-\int \vec{M}\cdot\frac{2\vec{H}(\vec{\xi}) + \vec{H}(O)}{2}\, d^3\vec{x} + O + \frac{d}{dt}\ldots \qquad (a)$$

where

$$O = +\sum_{i\,j\,k}\sum\sum \int \rho\, \xi_i\xi_j\xi_k \left(\frac{1}{4}\nabla_i\nabla_j E_k - \frac{1}{6}\nabla_i\nabla_k E_j\right) d^3\vec{x}$$

$$+\frac{1}{6}\sum_{i\,j\,k\,\ell}\sum\sum\sum \int \xi_i\xi_j\xi_k I_\ell \left(\nabla_i\nabla_k\nabla_\ell A_j\right) d^3\vec{x} + \ldots$$

stands for further electric and magnetic octupole and higher multipole interactions as far as not included already with the dipole and quadrupole interactions in the first two terms of the right hand side of eq.(a) Compare eq.(39a)). ρ and $\vec{I}$ are total charge and current density, but for explicit calculations the meson charge ("exchange charge") was neglected and

$$\rho = e\psi^\dagger \frac{1 + t_z}{2}\psi \qquad (13)$$

was used. This approximation, satisfactory at energies below 50 Mev is not quite so good at the energies>90 Mev that were considered in this thesis.

$\vec{\xi}$ are the coordinates measured from the center of gravity of the deuteron. $\vec{E}$ $(\vec{\xi})$ and $\vec{H}(\vec{\xi})$ stand for the electric and magnetic field at distance $\vec{\xi}$ from this center of gravity, $\vec{A}$ for the vector point at this point, $d^3\vec{x} = d^3\vec{\xi}$. $\vec{M}$ is the magnetization of the deuteron at this point; it is defined by

$$\vec{M} = \frac{1}{2}\vec{\xi}\times\vec{I} \qquad (35)$$

where $\vec{I}$ will include meson currents. As we have insufficient information on the properties of meson, eq.(35) was for practical calculation replaced by (compare eq.(9))

$$\vec{M} = \psi^\dagger \frac{e\hbar}{2Mc}\left(\frac{1 + t_z}{2}\mu_p + \frac{1 - t_z}{2}\mu_n\right)\vec{\sigma}\ \psi, \qquad (b)$$

the integral of which is experimentally known to be a good approximation for the magnetic dipole moment of the deuteron. As only central forces were taken into account for the interaction of the nucleons through the meson field, this approximation would be sufficient. However, there are no reasons for believing that the magnetic quadrupole interactions calculated for (b) should be correct.

The term $\frac{d}{dt}\ldots$ in (a) can be omitted as only first order perturbation theory was used in calculating the cross-sections. The central forces between the nucleons were taken as a 50-50 mixture of Majorana forces and of ordinary forces as proposed by Christian and Hart (compare eq.(41d)

$$U = \frac{1}{2}\left\{1 + (-1)^\ell\right\} V(\gamma) \qquad (c)$$

There is little reason to believe that this potential is correct, and for the ground state of the deuteron, where it was also used, its lack of spin dependence is definitely in disagreement (as eq.(c) would give the same binding for a ^1S state as for the ^3S state). However no better interaction potential for the high energy region is known today. For $V(\gamma)$ a square well of depth V_0 and effective range γ_0 was taken (see eq.(49)).

The cross-section may be divided into an electric cross-section σ^E for transition with $\Delta m_s = 0$, if the photon enters along the z-axis, and a magnetic cross-section σ^M for transitions with $\Delta m_s = \pm 1$ in this case. The expansion in multipole contributions on which the calculations are based, do not converge quite so good at energies > 90 Mev for the photon. This is the reason why different approximations made for transitions to final states with $\ell = 0$, or $\ell = 1$ gave substantially different numerical results. The formulas obtained for the cross-sections are:

σ^E for final state with $\ell = 1$:

$$\sigma_{\ell=1} = \frac{\pi}{6}\frac{\ell^2}{\hbar c}\sqrt{\frac{Mc^2}{E_f}}\, k \left|\sqrt{\mathcal{L}}\right.$$

$$\left.\int_0^\infty rF_{f_1}(r)\,\frac{1 + \sqrt{\frac{\pi}{k\gamma}}\, J_{1/2}(k\frac{\gamma}{2})}{2}\, F_i(r)dr\right|^2 \qquad (22)$$

$$\sigma_d = \frac{\pi}{6}\frac{\ell^2}{\hbar c}\sqrt{\frac{Mc^2}{E_f}}\, k\left|\sqrt{\mathcal{L}}\right. \int_0^\infty rF_{f_1}(r)\, F_i(r)dr\Big|^2 \qquad (23)$$

σ^E for final state with $\ell = z$:

$$\sigma_{\ell=2} = \frac{\pi}{120}\frac{\ell^2}{\hbar c}\sqrt{\frac{Mc^2}{E_f}}\, k \left|\sqrt{\mathcal{L}}\right.$$

$$\left.\int_0^\infty rF_{f_2}(r)\, 3\sqrt{\frac{\pi}{k\gamma}}\, J_{\frac{3}{2}}(k\frac{r}{2})\, F_i(r)\, dr\right|^2 \qquad (26)$$

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$$\sigma_q = \frac{\pi}{120}\frac{\ell^2}{\hbar c}\sqrt{\frac{Mc^2}{E_q}}\,k\left|\sqrt{\mathcal{L}}\int_0^\infty rF_{f\,2}(r)\,k\frac{r}{2}\,F_i(r)\,dr\right|^2 \quad (28)$$

σ^M for final state with $\ell = 0$:

$\sigma_{md} = 0$ (compare eq.(10))

for final state with $\ell = 1$ (hoping the best for the choice eq.(b) for M):

$$\sigma_{mq} = \frac{1}{9}\left(\frac{E_\gamma}{Mc^2}\right)^2(\mu_p^2 + \mu_n^2 - \frac{2}{3}\mu_p\mu_n)\,\sigma_d \quad (29)$$

Here

E_γ = $\hbar ck$ = the incident photon energy in the center of gravity system.

E_f = the final energy of the nucleons in the center of gravity system.

M = nucleon mass.

$\mathcal{L}$ = radius of spherical volume $V = \frac{4\pi}{3}\mathcal{L}^3$, in which we normalized the final spatial wave function of the disintegrated deuteron,

$$\mu_{f\ell}(\vec{r}) = \frac{F_{f\ell}(r)}{\gamma}\,Y_{\ell m}(\vartheta, \varphi)\ ; \quad (46)$$

while the spatial wave function of the deuteron in its ground state was

$$\mu_i(\vec{\gamma}) = \frac{1}{(4\pi)^{1/2}}\frac{F_i(r)}{\gamma}\ ,$$

$\sigma_{\ell=1}$ and $\sigma_{\ell=2}$ were found expanding the expression $e^{i\vec{k}\cdot\vec{\xi}} = e^{ik\xi\cos\theta}$ appearing in the matrix element by

$$\sqrt{\frac{\pi}{2k\xi}}\sum_{\ell'=0}^{\infty} i^{\ell'}(2\ell' + 1)J_{\ell'+\frac{1}{2}}(k\xi)\,P_{\ell'}(\cos\theta)$$

and neglecting terms with $\ell' \geq 2$. σ_d, σ_q, σ_{md}, σ_{mq} were calculated using a Taylor expansion for $e^{i\vec{k}\cdot\vec{\xi}}$ and using only the first two terms $(1 + ik\xi\cos\theta)$. Numerical results can be found below eq.(28) and in section 3. Our eq. (29) is different from the formula published by Marshall and Guth. All cross-sections were calculated in the center of gravity system of photon and deuteron. The energy of the photon in the laboratory system is

$$E_\gamma' = E_\gamma\sqrt{\frac{\sqrt{4M^2c^4 + E_\gamma^2} + E_\gamma}{\sqrt{4M^2c^4 + E_\gamma^2} - E_\gamma}}\ ,$$

which will be about 9% more than E_γ for $E_\gamma \sim 150$ Mev.

48 pages. $1.00. Mic 56-1822

POSITRONIUM FORMATION IN GASES: THEORY OF THE EFFECT OF AN ELECTRIC FIELD

(Publication No. 16,348)

Werner Bernhard Teutsch, Ph.D.
University of Pennsylvania, 1956

Supervisor: Vernon W. Hughes

A theory is developed to explain the influence of an electric field on positronium formation in gases. The Boltzmann equation is used to describe the behaviour of the positrons under the combined influence of the electric field and molecular collisions. A diffusion equation in velocity space is deduced wherein the annihilation of free positrons and the disappearance of positrons by positronium formation are absorption terms. With this equation the functional dependence of the increase in positronium formation as a function of the experimental parameters is calculated. The result describes correctly the experimental observations and yields information on the pertinent atomic processes. In particular, the cross sections for the elastic scattering of positrons by helium, neon, and argon are found to be $0.023\pi a_0^2$, $0.12\pi a_0^2$, and $1.5\pi a_0^2$, respectively, to within about ± 25 per cent. These values are considerably smaller than the corresponding quantities for electrons, and are in agreement with simple theoretical estimates. 100 pages. $1.25. Mic 56-1823

PHYSICS, ELECTRONICS AND ELECTRICITY

THE DECAY OF THE TRIPLET P LEVELS IN THE FIRST EXCITED CONFIGURATION OF NEON DURING THE AFTERGLOW OF AN ELECTRICAL DISCHARGE

(Publication No. 16,633)

Jack Richard Dixon, Ph.D.
University of Maryland, 1956

Supervisor: Professor Frank A. Grant

The mechanisms by which the metastable levels ($^3P_2$, $^3P_0$) and the associated radiating level ($^3P_1$) of neon decay in the afterglow of an electrical discharge have been investigated experimentally. The decays of the populations of these levels were studied individually by measuring the absorption of an appropriate neon spectral line at known time intervals after the cessation of the excitation.

A discussion of various metastable destructive mechanisms is presented. Theoretical metastable decay relations based on the work of Zemansky and Phelps are derived and discussed. Previous work pertinent to this study is reviewed.

The relationship between absorption and the density of excited atoms producing the absorption has been determined experimentally for various sampling lines. It is shown that this experimental relationship deviates markedly from the usual theoretical one. It is proposed that this deviation is related to line broadening phenomena

not included in the usual theoretical development. The validity of this experimentally determined relation was substantiated by various consistency tests using experimental decay data. For example, the sampling line anomaly reported by some previous workers is shown to be removed when data are plotted according to experimentally determined absorption-atom density curves.

The dependence of the decays of the triplet P neon levels on excitation current was studied. The decays of the $^3P_1$ and $^3P_0$ levels were found to be strongly current dependent at normal excitation currents. At extremely low excitation currents, however, the experimental data indicate that the $^3P_0$ decay becomes current independent. The decay of the $^3P_2$ level showed only a small current dependence in the early part of the afterglow. The current dependence is attributed to destruction of excited atoms by electrons left over from the excitation pulse.

The pressure dependence of the mean life of the $^3P_2$ metastable level was studied. It is shown that the experimental data are consistent with Phelps's theoretical decay equation which takes into account the effects of collision induced transfers of atoms from the $^3P_1$ radiating level to the $^3P_2$ metastable level during the afterglow. The relationship between this feeding mechanism and the imprisonment of $^3P_1$ resonance radiation is discussed.

The pressure dependence of the mean life of the current independent decay of the $^3P_0$ level was studied. The experimental data are shown to be in agreement with the Zemansky theoretical decay relation. Feeding mechanisms analogous to the one associated with the $^3P_2$ level do not seem to be significant to the decay of the $^3P_0$ level. This latter point was tested further by studying the pressure dependence of the decay of the $^3P_0$ neon level in helium-neon mixtures. The results are shown to substantiate the previous evidence that feeding mechanisms are not a significant factor in the decay of the $^3P_0$ level.

175 pages. $2.19. Mic 56-1824

CONCERNING THE HYDROGEN-PALLADIUM SYSTEM

(Publication No. 16,662)

Paul August Silberg, Ph.D.
Syracuse University, 1956

In spite of all the work done in attempting to understand the hydrogen-palladium system there still seems to be some controversies and sketchy knowledge concerning it. The present work is an attempt to clarify some of this vagueness.

During the thermal diffusion of hydrogen through palladium the emission of positive ions is both confirmed and denied in the reports of different investigators. The present work utilizing mass spectrographic techniques has resolved this controversy by exhibiting spectrographs of positive hydrogen ions emitted from hot palladium diffusing hydrogen and collected, using small collector potentials. X-ray diffraction pictures show the formation of large crystallites resulting from the thermal diffusion of hydrogen. This seems to be the so called "poisoning" effect noticed by some investigators. A qualitative explanation is offered for the ion emission.

The thermal diffusion of hydrogen through palladium has been studied by others in the high pressure and temperature region but little information for pressures below atmospheric is available. We have made thermal diffusion studies of hydrogen through palladium for the low temperature and pressure range and two transition points have been located. It has been found that the diffusion is independent of the sample thickness. A qualitative explanation is offered based on the changes of phase of the hydrogen palladium system due to temperature and hydrogen pressure.

A broad survey of the literature has been made.

100 pages. $1.25. Mic 56-1825

SURFACE REACTIONS IN SOME ALKALINE EARTH OXIDES UNDER ELECTRON BOMBARDMENT

(Publication No. 16,567)

Peter Wargo, Ph.D.
University of Minnesota, 1956

Adviser: W. G. Shepherd

The evolution rates of oxygen from BaO, SrO and MgO under electron bombardment have been measured quantitatively as a function of the bombarding electron energy and current density. The evolution of oxygen was detected by an omegatron mass spectrometer. Using radioactive Sr^{89} the rate of evolution of Sr from SrO under electron bombardment was also determined.

The threshold bombarding energies found to produce dissociation are: 9.5 ± 0.5 e.v. for BaO, 14.0 ± 0.5 e.v. for SrO and 16.9 ± 0.5 e.v. for MgO. It was observed that under the conditions of these experiments, the oxygen evolution rate varies as the square of the bombarding current density from the threshold to 700 e.v. and that the evolution rate is independent of temperature. The energy dependence of the oxygen liberation rate indicates that at low bombarding energies dissociation takes place at the surface and at higher energies dissociation apparently takes place due to reactions deeper in the oxide.

The rate of evolution of Sr from SrO agrees with the oxygen evolution at low energies. At higher energies and low temperatures the metal evolves much more slowly than the oxygen. By increasing the temperature of the target the metal evolution rate increases and at 700°C it was found that the metal evolves at the same rate as oxygen.

Taken together the data indicate that dissociation evidently takes place as a result of a double electronic excitation of the oxygen ions. 60 pages. $1.00. Mic 56-1826

AN INVESTIGATION OF NON-ROTATIONALLY SYMMETRICAL ELECTROSTATIC ELECTRON OPTICAL LENSES

(Publication No. 12,519)

Romayne Flemming Whitmer, D.E.E.
Polytechnic Institute of Brooklyn, 1956

The spherical aberration of electrostatic electron optical lenses seriously limits the resolving power of such

lenses. It has been demonstrated that for rotationally symmetrical lenses this aberration cannot be made zero and furthermore it is always positive. It has also been shown that lenses which are not rotationally symmetrical may have a spherical aberration which can be made zero although no method for finding such a field has been given.

In this paper electrostatic lenses which are non-rotationally symmetrical, constant in time, free of space charge, and in which the electrostatic potential along the axis of the lens does not fall to the cathode potential, are investigated. In general non-rotationally symmetrical lenses do not produce point-to-point imaging, that is they suffer from first order distortion and astigmatism. A method is given for determining lenses of the assumed symmetry which are free of first order distortion and astigmatism. This is accomplished by deriving the field equations and the paraxial ray equations for a general non-rotationally symmetrical lens. These equations involve an arbitrary parameter $\phi_2(Z)$ which appears due to the assumed symmetry. A relationship between this parameter and $\phi(Z)$, the axial potential distribution is then found such that the lens produces a point-to-point image. In order to obtain this it is assumed that the change in the paraxial ray paths from what they would be for the $\phi(Z)$ lens alone is small. An example of a non-rotationally symmetrical lens which produces a point-to-point image is given assuming that $\phi_2(Z)$ can be written as a polynomial in Z and that $\phi(Z)$ is given by the axial potential between two coaxial cylinders. The calculations were performed by numerically solving the paraxial ray equations on a card programmed electronic calculator. It is shown that the construction tolerances of such a lens may seriously limit the possibility of producing a lens of this type.

The equations for the geometrical aberrations are derived and these equations involve an arbitrary parameter $\phi_4(Z)$ as well as $\phi_2(Z)$. Equations are then derived which state the conditions between $\phi_4(Z)$, and $\phi_2(Z)$, and $\phi(Z)$ which must be satisfied, for a lens to have zero spherical aberrations. With the given assumptions it is shown that a lens of zero spherical aberration cannot be obtained, however, the aberration may be reduced. A method is given for finding fields of reduced aberration assuming $\phi_4(Z)$ can be written as a polynomial in Z. However, due to the number of arbitrary parameters a trial and error method would have to be employed in an attempt to actually reduce the spherical aberration. Several aberration figures that may be expected from such lenses are plotted and lenses which have a negative spherical aberration over a portion of the aperture plane are found. A possible method for constructing one of the lenses is also given.

The method for investigating non-rotationally symmetrical lenses, while lengthy, is straight-forward and allows the problems of imaging and reduction of the spherical aberration to be attacked separately. Further investigations assuming different functions for the arbitrary parameters $\phi_2(Z)$, $\phi_4(Z)$, and $\phi(Z)$ may now be carried out with ease in an attempt to reduce the spherical aberration of electrostatic lenses. The aberration figures plotted may also help to explain patterns obtained experimentally due to construction assymmetries in rotationally symetrical lenses. 115 pages. $1.44. Mic 56-1827

PHYSICS, NUCLEAR

NUCLEAR MAGNETIC RESONANCE IN HOMOGENEOUS MAGNETIC FIELDS

(Publication No. 16,624)

Charles Robert Bruce, Ph.D.
Washington University, 1956

Chairman: Dr. Richard E. Norberg

A high resolution nuclear magnetic resonance spectrometer was constructed. The field of a permanent magnet was homogenized by means of a carefully shaped set of ferromagnetic shims to have a resolution of 1 in 6×10^6 over a 12×10^{-3} milliliter volume. When spinning the nuclear sample, the best resolution was about 1 in 3×10^7 over the same volume of field. A Meacham oscillator of high frequency stability was used to take full advantage of this resolution. The apparatus used the bridge method to isolate the nuclear resonance signal from the oscillator voltage and conventional commercial equipment was used to amplify and display the resonance spectra.

An analysis of the response of the circuit to the nuclear resonance showed that in high resolution experiments conventional bridge balance conditions could not be used and also that circuit parameters could limit the resolution attainable with the apparatus under certain conditions. An expression for the half width at half maximum intensity was found to be $\Delta\omega = 3[(1/T_2) + 2\pi f Q \chi_0 \omega_0]$ where T_2 is the "transverse" relaxation time, f is the filling factor, $Q = R/\omega L_0$ is the coil parameter, χ_0 is the static nuclear paramagnetic susceptibility, and ω_0 is the frequency at the center of the resonance.

Two experiments were performed. The first was a study of the electron exchange reaction between N,N, N′,N′, tetramethyl-p-phenylenediamine (TMPD) and the one electron oxidation state, Wurster's Blue (WB), by measurement of line breadths of the proton resonances of TMPD as a function of WB concentration. The sample was a liquid containing four types of protons distinguished by the chemical shift. These are ring and methyl protons of TMPD and water and acetate ion protons. The proton resonance spectrum consists of four lines. In the presence of WB the resonances due to TMPD protons are broadened from 0.4 to 7.0 milligauss as the concentration of WB is increased from zero to 2×10^{-3} molar, but the water and acetate resonance lines remain about 0.4 and 0.2 milligauss respectively. From this it is concluded the electron exchange reaction rate constant is $(2.5 \pm 0.2) \times 10^4$ liter/mole-second.

In the second experiment line shape functions of the F^{19} resonance of a fluorite crystal were investigated. The theory of magnetic dipole-dipole interaction of magnetic moments located on a simple cubic lattice and past experimental results on this crystal are further substantiated by the new data. 63 pages. $1.00. Mic 56-1828

A TWO-BODY RELATIVISTIC TREATMENT OF FERMION-BOSON AND BOSON-BOSON BOUND-STATE EQUATIONS

(Publication No. 16,766)

Norma H. Eisen, Ph.D.
New York University, 1956

Research Adviser: Dr. Robert D. Hatcher

Using a formalism developed by Feynman and extended to bound-state problems by Salpeter and Bethe, a relativistic bound-state equation for the interaction of two particles is first developed. In separate sections, restrictions are then imposed to make the equation applicable specifically to the problem of the interaction of a Fermi-Dirac particle with a Bose-Einstein particle, and to the problem of the interaction of two Bose-Einstein particles with each other, respectively. With the use of Fourier transforms, each of the equations is expressed in momentum space. Using an approach introduced by Salpeter, an exact three-dimensional equation is derived from the four-dimensional one, for the Fermion-Boson and Boson-Boson problems respectively, for the case where an instantaneous interaction function is to be considered. Since the main portion of the interaction between the two particles, in each case, is the instantaneous Coulomb part, solutions of these three-dimensional equations, using a Coulomb potential, give a good approximation to the solution of each of the problems. The three-dimensional equations for the Fermion-Boson and Boson-Boson cases are further shown, in the extreme non-relativistic limit, to reduce to the Fourier transform of the non-relativistic Schroedinger equation. On the basis of the respective three-dimensional equations, perturbation theories are developed for the Fermion-Boson and Boson-Boson problems so as to permit the determination of the energy level shifts when there are, in addition to the Coulomb potential, small extra interactions which may or may not depend upon the fourth component of the momentum.

The three-dimensional equations for the instantaneous Coulomb interaction, and the expressions for the shift in the energy levels due to extra perturbation interactions for the Fermion-Boson and Boson-Boson cases are next compared with those which have been obtained by Salpeter for the Fermion-Fermion case, and similarities and differences are noted. Interaction functions are written down for both the Fermion-Boson and Boson-Boson problems, and, for a single photon interaction, the Coulomb portion is separated out in each case. Then, for the Fermion-Boson problem, a partially relativistic equation is developed from the completely relativistic one, and this partially relativistic equation is compared with the Breit equation for the Fermion-Fermion problem.

Methods of solution of the three-dimensional equations for both the Fermion-Boson and Boson-Boson problems, and the difficulties of each of these methods, are next discussed, and a method of solution of one-body momentum-space wave equations which was developed by Levy is shown to be applicable to the solution of two-body equations for the case where the two interacting particles are identical. The two-body Fermion-Fermion equation is shown to reduce, for identical particles, to the momentum-space form of the Dirac equation, which has been solved by Levy. The two-body Boson-Boson equation is then set up, and, for identical Bosons, a solution is carried out by Levy's method. Finally, as an example of the use of the perturbation theories, a perturbation calculation of the energy shift due to two instantaneous photons simultaneously in the field is performed for the Fermion-Boson problem, and the result is compared with that of a similar calculation performed by Salpeter for the Fermion-Fermion problem. A similar calculation of the energy shift due to such a perturbation interaction is indicated for the Boson-Boson problem.

103 pages. $1.29. Mic 56-1829

A THEORETICAL STUDY OF EXCITATION AND IONIZATION BY ELECTRONS IN HELIUM AND OF THE MEAN ENERGY PER ION PAIR

(Publication No. 16,482)

William Frederick Miller, Ph.D.
Purdue University, 1956

Major Professor: Robert L. Platzman

A detailed investigation of the inelastic scattering cross-sections for electrons in helium has been made. The results have been applied to the calculation of the over-all efficiency of excitation and ionization accompanying penetration of electrons in helium gas.

As a first step, the dispersion of helium was studied thoroughly, and a complete and consistent set of oscillator strengths between the ground level and excited levels, including levels of the continuum, was derived. Extensive use was made of both theoretical and experimental information. From these oscillator strengths, the mean excitation potential for the stopping power of helium was found to be 41.8 ev.

By exploiting the intimate relationship between inelastic scattering cross-sections and optical properties of matter, as well as that part of experimental information on cross-sections which analysis showed to be trustworthy, a consistent set of excitation and ionization cross-sections was derived. These cross-sections were then used to calculate the stopping number for slow electrons. Also calculated were the mean excitation yield for excitations of the 2^1P level, for electrons with kinetic energy from 0 to 200 ev, and the mean energy per ion pair, W, for electrons with kinetic energy from 0 to 2 kev. Especially interesting is the dependence of W on the energy of the penetrating electrons; W was found to be very large at low electron energies, decreasing monotonically with increasing energy for energies above 100 ev. The variation with energy between 1 kev and 2 kev is very small. At 2 kev, W was found to be 46.5 ev for low gas pressures.

180 pages. $2.25. Mic 56-1830

STUDIES IN THE SYMMETRICAL FISSION OF NATURAL URANIUM

(Publication No. 15,615)

Hermon Reginald Milley, Ph.D.
Purdue University, 1953

Major Professors: R. M. Steffen and Ernst Bleuler

The neutron-induced symmetric fission yields of natural uranium are investigated for three cases of neutron energies. The fission pulses, initiated in a double ionization chamber, are selected by two single-channel pulse height analyzers which establish a system of two "channels," one corresponding to each section of the chamber unit. Measurements are taken by using one channel as the energy gate and varying the other over the region of interest.

After the preliminary calibration of the apparatus, the single count distributions are taken. For the thermal neutron fission of U^{235} the most probable energies of the light and heavy fragment groups, and the ratio of these energies, are found to be in good agreement with the published values. This serves as a check on the energy calibration.

The Be + d and D + d reactions are employed for the fast neutron fissions. The neutron energy spectrum for the D + d reaction is determined by the analysis of a nuclear photographic plate. Two peaks, of mean energies 4.6 Mev and 8.9 Mev result. The spectrum mean is 6.0 Mev. Previous work on the Be + d reaction had already established a mean value of 3.5 Mev for the neutron energy spectrum, under the conditions of this experiment.

For the gated runs, each channel was biased to a window width of 5.5 Mev. The coincidence pulse distributions are obtained from the oscillograph photography of those pulses from the linear amplifier output of the ungated channel which are initiated by the application of coincident pulses from the gated channel output to the trigger circuit of the oscilloscope.

Analysis of these coincidence distributions shows an increase in symmetric yield in going from thermal neutron fission to fission induced by D + d neutrons. The total symmetric fission counts obtained are (260 ± 16) and (310 ± 18), respectively. For the case of Be + d neutron irradiation however, no increase over that given for the thermal neutron case is indicated.

For the comparison of results arising from these experiments with those given by Fowler, Jones and Paehler, for the asymmetry of fission as a function of excitation energy, the ionization yields given here are converted to equivalent mass yields. The calculations show the equivalent mass yield for the case of thermal neutron fission to be higher than expected. The plot of the data for each of the three cases of neutron irradiation, however, lies within the scatter of points used by the above-mentioned authors in the construction of the functional relation they propose.

The probabilities of the fission modes for U^{235} fission in the vicinity of energy symmetry are plotted along with neighboring comparison contours taken from the results of Brunton and Hanna. 97 pages. $1.21. Mic 56-1831

THE INVESTIGATION OF EXCITED STATES IN BERYLLIUM-8 BY THE SCATTERING OF ALPHA PARTICLES OFF HELIUM

(Publication No. 16,417)

Roy Nilson, Ph.D.
University of Illinois, 1956

Absolute, center of mass, differential scattering cross sections for alpha-alpha particle scattering have been measured at incident alpha particle energies of 12.3, 15.2, 17.8, 19.1, 20.4, 21.65, 22.25, and 22.81 Mev using photographic techniques. The angular range studied was 11^0 to 50^0 in the laboratory system. The accuracy is better than 3% at most angles in the five lower energy experiments and better than 2% at most angles in the three higher energy experiments.

The source of the incident alpha particles was the University of Illinois cyclotron. The reduction of energy from the primary alpha particle energy to 21.65 Mev was accomplished by varying the cyclotron capacity. Further reductions in energy were accomplished by using aluminum absorbers.

The nuclear phase shifts were calculated by ILLIAC, the University of Illinois digital computer. The energy variation of the S-, D-, and G-wave phase shifts derived from these data and considered in relationship to already existing lower energy phase shift data show conclusively that there are no broad even states in Be^8 other than the S-ground state, the 2.9 Mev D-state and a G-state at 11.8 Mev. A broad S-state at 7.5 Mev does not exist.

173 pages. $2.16. Mic 56-1832

THE DECAY OF NEON - 23

(Publication No. 16,539)

John Russell Penning, Jr., Ph.D.
University of Washington, 1955

The beta- and gamma- spectra of Ne^{23} were studied with stilbene and NaI scintillation spectrometers with the aid of a fast-slow coincidence arrangement and a twenty-channel analyzer. The half life for the decay was measured to be 37.63 ± 0.10 sec. Beta transitions direct to the ground state of Na^{23} were found to have an intensity corresponding to 67% of the disintegrations, a maximum energy of 4.39 ± 0.05 Mev, and a log ft value of 5.25. Beta transitions to the first excited state of Na^{23} have an intensity of 32%, a maximum energy of 3.95 ± 0.05 Mev, and a log ft value of 5.38. These betas are in coincidence with gamma rays of 436 ± 4 kev. Additional beta transitions take place to the second excited level of Na^{23} at 2.07 Mev and have an intensity of 1%, a maximum energy of 2.4 ± 0.1 Mev, and a log ft value of 5.88. These betas are in coincidence with gamma rays of 1647 ± 16 kev which in turn are in coincidence with gamma rays of 436 ± 4 kev. Less than 10% of the gamma decays from the 2.07-Mev state go directly to the ground state. Beta transitions to all states of Na^{23} higher than 2.07 Mev take place in fewer than 0.25% of the disintegrations, and fewer than 0.1% take place to any one such state. The disintegration energy of 4.39 ± 0.05 Mev which was determined from this experiment is in excellent

agreement with the value of 4.388 ± 0.007 Mev determined from nuclear reaction studies. This is in contrast with previous beta decay measurements. In addition, the previously reported superallowed beta transition to a level in Na^{23} at 3 Mev is shown not to exist. The results indicate that it is very unlikely that any superallowed transition takes place in the beta decay of Ne^{23}.

165 pages. $2.06. Mic 56-1833

THE COULOMB EXCITATION OF NEODYMIUM AND SAMARIUM NUCLEI BY PROTON BOMBARDMENT

(Publication No. 16,566)

Bowen Eugene Simmons, Ph.D.
University of Minnesota, 1956

By proton bombardment of thick neodymium metal and thick isotopically enriched samarium oxide targets, gamma rays of energies 456 ± 5, 300 ± 3, 131 ± 2, 562 ± 8, 337 ± 3, 124 ± 2, and 85 ± 3 kev from Nd^{146}, Nd^{148}, Nd^{150}, Sm^{148}, Sm^{150}, Sm^{152}, and Sm^{154}, respectively, have been excited and studied. Excitation functions and angular distributions of all except the two highest energy radiations indicate 2+ level assignments to corresponding first excited states. The WKB coulomb excitation theory of Alder and Winther correctly predicts the excitation functions but not the angular distributions, which are in accord with empirical results of McGowan and Stelson. Reduced transition probabilities from first excited to ground states, derived from gamma ray intensities, yield, via unified model strong coupling formulas, nuclear distortions which are a factor of four smaller than distortions similarly computed from level positions, but which agree with those computed by Ford from anomalous isotope shifts in optical spectra. Even-even nuclear trends and systematics are discussed.

188 pages. $2.35. Mic 56-1834

NUCLEAR REACTIONS WITH ALPHA PARTICLES (PARTS I AND II)

(Publication No. 15,407)

Ronald Neville Smith, Ph.D.
Purdue University, 1941

Major Professor: K. Lark-Horovitz

Part I: A Search for (alpha-2 Neutron) Nuclear Reactions.

In considering nuclear reactions Weisskopf[1]) has developed a statistical theory of the excited nucleus in which a knowledge of the detailed structure of the nucleus is not required. Weisskopf and Ewing[2]) have applied this theory to nuclear reactions and developed expressions for the cross-sections for different types of processes. From their work it was apparent that the 15 MeV alpha-particles from the Purdue cyclotron should be able to produce measurable yields of (alpha-2 neutron) reactions on elements in the middle part of the periodic system. Consideration of single particle binding energies in the nucleus predicted thresholds for this process below 15 MeV and the Weisskopf theory gave rapidly rising yields above this threshold. For these reasons a search was made for (α-2n) reactions on the medium heavy elements (A > 50). Only those elements were bombarded where the radioactivities produced would allow the identification of the process.

The alpha-particle reactions on the following elements were investigated: vanadium, cobalt, copper, gallium, arsenic, rubidium, yttrium, rhodium, silver, indium and iodine. The results of other workers on bromine, antimony[23]), and bismuth[24]) were examined. Some light elements were also checked. In no case was an (α-2n) reaction shown to take place with 16 MeV or less alpha particles. Most of the observed activities were shown to result from (α-n) processes. Some were inconclusive due to the difficulty of making precise isotope assignments.

This lack of (α-2n) yields is taken to indicate that Weisskopf's assumptions in regard to the energy level density distribution in an excited nucleus must be modified.

Part II: Isomeric States in Indium[112].

As a result of the bombardment of silver with 15 MeV alpha-particles in Part I, an indium activity was discovered whose decay curve exhibited a growth characteristic. A similar curve was observed in positron decay from indium bombarded with fast neutrons. Along with appropriate chemical identification this places the activity at In^{112}. The growth of the activity suggested isomeric states in In^{112}, the upper state decaying into the lower one, the activity of the lower level only being observed in the counter. On this assumption the curve was resolved into a 16.5 ± 2 minutes half-life for the upper state and 17.5 ∓ 2 minutes for the lower. Using an electroscope with a very thin window another activity was observed on top of the growth curve, having a half-life of 16 ± 5 minutes. This was assumed to be internal conversion electrons from a gamma-transition from the upper to the lower state. The range of these electrons in aluminum gave an energy of 0.124 ± .015 MeV for the energy difference of the two levels. The lower state appeared to emit both positrons and electrons. The upper energy limit of the positrons as determined from absorption in aluminum was 1.3 ± .1 MeV, and of the electrons 0.47 ± .07 MeV. It is not certain whether these electrons are beta particles from In^{112} to Sn^{112} or conversion electrons from a gamma ray, but the evidence points to the former conclusion. Another group of particles has been found associated with the decay of the lower state, with a range in aluminum corresponding to an electron energy of 0.065 ± .01 MeV. This has tentatively been assigned to a 0.095 ± .01 MeV gamma-ray following the beta-decay to Sn^{112}. The possibility of a third isomeric state is raised by the assignment[30]) of a 2.7 day activity to In^{112}. This assignment however, is not considered conclusive.

84 pages. $1.05. Mic 56-1835

*Please see thesis for bibliographical notes.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

EFFECTS OF ANOMALOUS MAGNETIC MOMENTS IN SCATTERING THEORY

(Publication No. 16,776)

David Spielberg, Ph.D.
New York University, 1956

Adviser: Professor Robert D. Hatcher

The elastic mutual scattering of two Fermi-Dirac particles of equal mass is studied, with special attention given to the interactions arising from the anomalous magnetic moments of the particles.

A scattering matrix element and differential cross-section for electron-electron scattering in the center-of-mass system are derived in the Heitler quantized field method, the energy of each electron in an electromagnetic field being taken to be the usual Dirac interaction, augmented by a Pauli term representing the additional anomalous magnetic moment energy. The matrix element obtained from this augmented interaction remains Lorentz invariant. It is shown to agree with the augmented matrix element as calculated using the methods of Møller and Feynman. The expression for electron-electron scattering cross-section obtained in this calculation is found to reduce to the Møller result if the parameters representing the anomalous magnetic moments are set equal to zero.

A section of this paper is devoted to the relativistic transformation equations for the conversions between the laboratory and center-of-mass coordinate systems. Several useful theorems in the relativistic kinetics of collisions of equal bodies are cited and proved. Some results of this section are used to transform the electron-electron scattering formula to the laboratory coordinate system.

Numerical calculations carried out to determine the percent contribution of the anomalous magnetic moment terms to the electron-electron scattering cross-section show that for laboratory kinetic energies of up to 400 Mev, these contributions amount to less than $\frac{1}{2}\%$.

An approximation method is also developed to provide an estimate of the fractional contributions of the anomalous magnetic moment interactions to the scattering cross-sections in the cases of neutron-proton and proton-proton collisions. Only in the case of proton-proton scattering at very high energies is any appreciable effect found; the calculations indicate a contribution of at most about 4% to the scattering of 1-Bev protons by protons, with a scattering angle of 90^0 in the C.M. system. At lower energies and smaller scattering angles the predicted effects are still smaller. 123 pages. $1.54. Mic 56-1836

PHYSIOLOGY

CARDIOVASCULAR STUDIES IN ADRENAL INSUFFICIENT DOGS

(Publication No. 16,740)

Clarence F. Decker, Ph.D.
Michigan State University, 1954

An attempt was made to make certain cardiovascular measurements in a group of five trained, unnarcotized, bilaterally adrenalectomized dogs. Heart rate, blood pressure, stroke index and cardiac index were followed simultaneously in the same animal in different states of mild adrenal insufficiency. The cardiac index was determined from the contour of the pressure pulse curve according to the method of Hamilton and Remington. In this method the arterial pressure curve, produced by cardiac ejection of blood, is analyzed in terms of the volume of blood necessary to elicit the pressure fluctuation. To convert a pressure curve to blood volume requires consideration of pulse wave transmission times to various parts of the expansible arterial tree. This is justifiable on the basis that the volume of blood distending the vessel alters the rate of movement of the compression wave. The Hamilton-Remington tables for pulse wave transmission times at various pressures were used in the present work. A strain gage manometer and direct recording galvanometer were used to record the central pulse from the carotid artery.

The earliest noted circulatory alterations following bilateral adrenalectomy were a decrease in systolic and an increase in diastolic pressure with a corresponding reduction in the pulse pressure. A reduction in both stroke index and cardiac index was evident. These changes occurred before marked alterations in the electrocardiogram, blood non-protein nitrogen, plasma sodium or potassium had taken place. When adreno-cortical replacement therapy was withdrawn a progressive fall in cardiac output occurred which was roughly proportional to the severity of the adrenal insufficient state as indicated by blood chemistry and hematocrit changes. Re-administration of therapy resulted in an improvement in stroke index and cardiac index. This improvement often occurred even before marked improvement in blood chemistry had occurred.

It was suggested that the initial increase in diastolic pressure observed could be explained on the basis of an increased peripheral resistance. An increased peripheral resistance coupled with the observed reduction in cardiac output could be indicative of an inadequate blood volume, but the present data do not permit positive evaluation of this factor. The improved flow obtained when replacement therapy was again administered could be explained on the basis of a lowered peripheral resistance.

It was concluded that the present data indicate that considerable alteration in the output of the heart occurs in adrenal insufficiency before marked changes in blood chemistry and the electrocardiogram take place. It was suggested that a direct action of adrenal steroids on heart muscle might be implicated, but the possibility of their indirect effect upon the peripheral resistance is not ruled out by the data. 104 pages. $1.30. Mic 56-1837

POLITICAL SCIENCE, GENERAL

THE DEVELOPMENT OF DEMOCRATIC GOVERNMENT IN THE STATE OF NEW YORK THROUGH THE GROWTH OF THE POWER OF THE EXECUTIVE SINCE 1920

(Publication No. 16,765)

James Tracy Crown, Ph.D.
New York University, 1956

Adviser: Ray F. Harvey

Much of the discussion of the merits of strong executive type state government has been conducted on a highly theoretical level, with little reference to practice. This study analyzes the development of strong executive type government in its New York State environment. An examination is made of the office of the State governor at the time of its creation, and in the early twentieth century, just prior to the State's executive reorganization. The causes of a movement for a strengthened executive are examined along with the specific proposals of the supporters of this movement. In the period of the modern governor, subsequent to 1920, the various elements which contribute to strong executive leadership in administration and legislation are analyzed. On the basis of this analysis, an examination is made of the major criticisms of strong executive government as they apply to New York State.

In the study it is found that the State had an early tradition of a strong governor, but subsequent fear of government power resulted in great decentralization and restrictions on both executive and legislative power. The early twentieth century chief executive was hampered by a short term, election on presidential election years, inadequate appointing and removal powers, over-lapping terms for administrative officers, and an absence of clear lines of administrative authority. The legislature freely intervened in the administrative agencies and initiated most important financial legislation.

The decisive factor causing executive growth was the condition of industrialization and urbanization which created a public demand for more positive government and a larger, more efficient bureaucracy. The governor was chosen for the role of leadership not only because of the logical capabilities of leadership possessed, but also because the legislature was discredited as corrupt, boss-dominated and unrepresentative of State-wide interests — so much so in fact that legislative functions vital to a representative democracy were obscured.

Advocates of executive reform, who included, significantly, a mixture of practicing politicians and political scientists, proposed that more efficient, democratic government could be attained if the governor were granted sufficient power and adequate tools so that the public and the legislature could hold him responsible for honesty and efficiency in administration and for the enactment of desired legislation.

Through partial application of these proposals and through a fortuitous trend in political developments, the governor did become a legislative leader and an administrative chief who accepted responsibility for acting as such. The governor's legislative leadership rests on a basis of a relatively responsible political party system, his emergence as party leader, his veto, his authority and tools for initiating the budget and legislative programs, in addition to his direct appeal to the voters. In administration, in spite of a carry-over of many restrictive features of the early twentieth century administrative structure, the governor has a reasonable span of control through appointment and removal power and logical organization of agencies, which is buttressed by his budgetary control over all executive agencies. Also, in a comparative sense, generous provision has been made for agencies which provide the governor with advice and planning, and which enable him to exercise control over the administrative agencies.

It is concluded that during the Smith, Roosevelt, Lehman, and Dewey administrations the public was better able than before to fix responsibility for enactment of desired legislation and for efficient administration of government. The argument that the people have lost their liberties as a result of executive growth has not been found to be supported by reference to facts. The power of the legislature has been weakened considerably, but it still provides a strong check on the governor.

374 pages. $4.68. Mic 56-1838

THE "NEW CONSERVATISM" OF FORTUNE MAGAZINE (1930-1952)

(Publication No. 16,116)

James Russell Jensen, Ph.D.
State University of Iowa, 1956

Chairman: Professor Lane Davis

One of the most marked characteristics of post-World War II America has been the development of what has come to be called a "new conservatism." Much of this "new conservatism" is open to the criticism that it is irrelevant to American politics because it attempts to be conservative while rejecting wholly or in part the business community--that portion of American society which has traditionally formed the nucleus of American conservatism. The purpose of this study is to demonstrate that an analysis of the pages of FORTUNE magazine reveals a body of ideas which is conservative in its attempt to restore the lost power and prerogatives of the business community and new in its wholehearted acceptance of government as an instrument for controlling the business cycle.

This analysis begins with an examination of the efforts of the editors of FORTUNE to instill the business

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community with sound conservative principles and to assess for the American businessman the nature and strength of the social and political forces with which he must contend. In examining the background of FORTUNE's "new conservatism," its reactions to the New Deal, it is argued that the New Deal produced an ideological fragmentation of the business community rather than solidifying it. The "ideology" of this "new conservatism" is the story of how the free, creative individual, operating in a competitive environment implemented the American Dream of Abundance.

Part II is devoted to an examination of the way in which FORTUNE's "new conservatism" would govern American society. Prior to World War II FORTUNE advocated a number of reforms, not the least of which was a more rigorous enforcement of the antitrust laws. The criterion for enforcement was to be how the market was being served, not size per se. In the post-war period, however, FORTUNE becomes complacent and seems to feel that now the business community, because of a moral regeneration, is using its power in a socially beneficial manner.

If FORTUNE is optimistic about the health of the industrial sectors of the American economy, it is not so complacent about labor and agriculture. Organized labor, in FORTUNE's opinion, needs to be curbed and agriculture subjected to the free market.

Turning to the problems of taxation and the business cycle, it is discovered that FORTUNE would shift the incidence of taxes to the consumer. As for controlling the business cycle, FORTUNE accepts compensatory fiscal policy, public works, credit control, and other Keynesian techniques. The editors take issue, however, with those who advocate a policy of "full employment." In FORTUNE's opinion the objective should be an expanding economy which in turn means that the only valid goal is "reasonably" full employment.

Part II concludes with a discussion of what is here called the "new federalism" of "welfare capitalism." The purpose of this "new federalism," which would have corporations themselves satisfy the demands of the working man for security, is to place a check on government and to keep government out of the area of "managerial decisions."

In conclusion, FORTUNE's "new conservatism" is criticized on a number of grounds. The major criticism is that adoption of the policies advocated by FORTUNE would result in a society governed by the managers of modern industry and those who control them. FORTUNE can accept this type of society because it has so much faith in the moral qualities of the professional manager. It is suggested, however, that John Adams' formula of decentralized power as the best road to freedom is still valid. 287 pages. $3.59. Mic 56-1839

INTELLECTUAL ORIGINS AND ASPECTS OF POLITICAL THOUGHT IN THE JEN HSÜEH OF T'AN SSU-T'UNG, MARTYR OF THE 1898 REFORM

(Publication No. 16,542)

Nathan M. Talbott, Ph.D.
University of Washington, 1956

In the latter half of the nineteenth century, China was faced with a serious crisis. Her political institutions had deteriorated and she was faced with the aggressive expansion of the West. The Jen Hsüeh of T'an Ssu-t'ung (1865-1898) was a response to this crisis.

T'an Ssu-t'ung avidly read all that he could on Western subjects particularly in the fields of science and mathematics and enthusiastically embraced Western learning. He studied the tenets of Buddhism and became a fervent convert to its beliefs. Styling himself the disciple of K'ang Yu-wei (1858-1927), the leader of the 1898 Reform Movement, T'an was a follower of the New Text School of Confucianism. From this varied background he drew the essential ingredients which were incorporated into his ambitious attempt to construct a comprehensive synthesis. This background further provided T'an with the list of philosophers, works, and subjects which he deemed necessary for an understanding of his central idea, Jen. This list, placed at the beginning of the Jen Hsüeh, demonstrates from the outset the broad eclecticism of his work.

The Jen Hsüeh, T'an's only major philosophical work, is divided into two parts, but beyond this there is no formal organization. A number of thematic ideas recurring throughout the treatise provide some coherence for a long, and otherwise loosely constructed essay. Basing himself primarily on Buddhist philosophy but supporting this with illustrative material from Confucianism, Christianity and Western science, T'an envisaged a utopia of universal oneness and equality. The key to the attainment of this utopian world is Jen which is the essence of the inherent goodness in man and, when practised, expresses itself in feelings of love, understanding and commiseration. The power of Jen will unify all mankind in a state of perfect equality.

T'an Ssu-t'ung, in some respects, was the most radical thinker among the men who sought a solution to the crisis of the times. He bitterly condemned the social and political tenets of the imperial Confucianists who upheld the official ideology as representatives of the court. Legitimizing his position with citations from the Confucian classics, he called for the elimination of the existing rigid system of political and social institutions. These he regarded as 'nets' which entrapped men in meshes of iniquity and tyranny. He asked for the emancipation of women and an enlightened attitude toward sex; he bitterly denounced the authoritarian family system and the utter subjection of social and political inferiors to their superiors; endorsing violent revolution, he called unequivocably for the overthrow of tyrannous rulers who regarded the country as their private estate. With these obstructive 'nets' out of the way, and with the realization of individual freedom, his country could enter a realm of unlimited progress, an idea which he derived from his limited contact with the nineteenth-century philosophy of the Western world. In his utopian realm, the government would be of a form which would give expression to the desires of the people. They would have the right to remove an undesirable ruler

and a voice in determining their own political destiny. International trade and intercourse would be open and unrestricted. The full utilization of science, its instruments and knowledge, would eradicate poverty and physical suffering from the earth. All men would live together in comfort and harmony.

T'an Ssu-t'ung's contact with Western learning was necessarily superficial and fragmentary and there were others who were more thorough scholars than he, but despite these shortcomings he wrote with an ardor, courage, and imaginative flair that was unsurpassed in his time. Without direct contact, he was able to see truths in Western thought and applied them to his concept of universalism. Impassioned, bold, and a man of vision, T'an Ssu-t'ung demonstrates in the Jen Hsüeh that, in the words of one biographer, he is worthy of being regarded as a "new comet in the intellectual circles of his time".

398 pages. $4.98. Mic 56-1840

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

THE AMERICAN NAVAL VISITS TO GREECE AND THE EASTERN MEDITERRANEAN IN 1946: THEIR IMPACT ON AMERICAN-SOVIET RELATIONS. A CASE STUDY OF THE FUNCTIONS OF MODERN SEA POWER IN PEACETIME FOREIGN POLICY.

(Publication No. 16,299)

Stephen George Xydis, Ph.D.
Columbia University, 1956

Three days before the first atomic explosion at Alamogordo on July 16, 1945, a former Greek premier not lacking in astuteness declared, on what he considered good authority, to the Committee on Foreign Affairs meeting in Athens in closed session, that the Americans who had conceded to the British a preponderant role in Greece would soon withdraw completely from the Greek scene in which they were playing a role only in relief and rehabilitation. However, less than two years later President Truman announced to Congress his plan to aid Greece and Turkey. This dissertation generally seeks to show how, even before the British announced they could no longer bear the burden of supporting those two countries, the expectations of the Greek politician were not fulfilled.

On September 2, 1945, after two more atomic explosions, the U.S.S. Missouri lay at anchor in Tokyo Bay. Aboard it the Japanese signed the instrument of their surrender. Less than seven months later, on March 21, 1946, the same battleship left Bayonne, New Jersey. Aboard it this time was a coffin draped in the Turkish flag. It contained the remains of the Turkish Ambassador to the United States who had died in 1944 in Washington. The Missouri, after crossing the Atlantic, steamed through the Mediterranean, first among its sister battleships ever to pass Gibraltar, entered the Turkish Straits and anchored off Istanbul. On its way back it stopped off at Athens for four days. Its voyage was the beginning of the build-up of the American fleet in the Mediterranean. Other naval visits to Greece and Turkey followed that year. What was the meaning of these naval movements? What was the international reaction to them? These, together with hypotheses on the functions of modern naval power in peacetime, are some of the particular problems with which this dissertation deals.

Although lack of access to American archives did not permit the writer to establish conclusively the anti-Soviet character of these naval movements, the study of published material strongly supports the interpretation that these movements were meant to call attention to a change in American foreign policy toward the Soviet Union, and that, with Byrnes frequently absent from Washington at international meetings, this policy was shaped by President Truman and his Secretary of the Navy, James Forrestal.

Hitherto unpublished documents from Greek Government archives at any rate show that since February, 1946 these naval movements were meant to convey the expression of direct American interest in Greece and by inference in Turkey. Formally carried out independently from Britain, these naval moves embryonically, as it were, revealed the shape of things to come when early in 1947 the British Government announced that it would be unable to continue aiding Greece and Turkey. Instead of helping the British to carry on, the American Government itself stepped into the picture with the "Truman Doctrine."

If lack of American diplomatic support of certain Greek claims at the Paris Peace Conference appeared to have somewhat adversely affected the impact of the American naval visits to Greek ports at the end of 1946, the Truman program of assistance, by substituting for symbolic gestures of friendship concrete measures of substantial economic aid, tended to resolve the problem inherent in the American policy of opposing the Greek claims and of seeking at the same time to encourage the Greeks to resist the expansion of the Soviet bloc into the Mediterranean. As for the American warships in that sea, they have remained there ever since, as instruments of peacetime diplomacy, as agents of deterrence, and as constant reminders of American power to the nations in that strategic region of the world. 352 pages. $4.40. Mic 56-1841

PSYCHOLOGY, GENERAL

PRE-RETIREMENT PROBLEMS AS RELATED TO THE SELF CONCEPT OF THE INDIVIDUAL

(Publication No. 16,527)

Paul D. Walter, Ph.D.
University of Pittsburgh, 1956

The purpose of this investigation was to determine the relationship between degree of personal maladjustment, as measured by the self concept, acceptance of self, and discrepancy between these factors, and amount of anxiety for retirement problems as seen by a group of men who were facing imminent retirement. The general hypothesis was: Those individuals who have compatible self concepts look forward to retirement with less apprehension than those with incompatible self concepts. The specific hypothesis was: There is a positive correlation between the degree of personal maladjustment and the amount of anxiety in facing the problems of future retirement.

A sample of 54 males was obtained with 90 per cent (N = 48) cooperating in the study. One group of 17 was contacted personally during a pre-retirement conference; the remaining 37 were contacted by mail. The subjects were considered to be relatively homogeneous with respect to health, financial security after retirement, long continuous employment with one company, having had company supervised pre-retirement planning, and not wishing to retire prior to age 65. The sample was heterogeneous with respect to type of occupation and educational level.

A modification of The Index of Adjustment and Values was used to measure the degree of personal maladjustment. An inventory consisting of twelve multiple-choice questions and one open-ended question was constructed to assess degree of anxiety for retirement. Two of the multiple-choice items and the open-ended question were not scored, the former being neutral items and the latter being included for future revision of the inventory. The choices to the scorable questions were graduated in intensity to the listed problem and weights from one to five were assigned a priori according to the amount of concern indicated. The obtained reliability for the inventory by test-retest method was .954 which was significant at the .001 level of confidence. An item analysis of the inventory revealed that one question failed to discriminate significantly between the dichotomy of high and low anxiety for retirement as measured by the inventory, three discriminated at the .05 level, and six at the .01 level.

A correlation of The Index of Adjustment and Values and the newly devised inventory was determined by the Pearson product moment r technique. The resulting coefficient of correlation (.614) was significant at less than the .001 level of confidence indicating a close negative relationship between degree of self-acceptance and problems of retirement as seen by a retiree. The results of this study indicated that those individuals facing retirement within one to three years who are relatively well adjusted in their daily living are not nearly as concerned with retirement problems as people who are less well adjusted. Caution should be exercised in generalizing the results of this study to populations which are different from those in the sample under investigation.

Since relatively little research has been pursued in this area, suggestions for future research have been indicated. Replications using the newly devised inventory would provide additional checks for reliability. Studies to determine the validity of the questionnaire should be undertaken. Research with various controls other than the ones used in this study would be beneficial. Those suggested included varying the degree of health, financial security, attitudes toward wanting to work or being retired, problems of the retiree versus the pre-retiree, the possibility that some anxiety for retirement problems before one is actually retired may assist in solving or partially resolving problems before they become a reality, and a determination of qualitative and quantitative differences between the problems of the pre-retiree as he considers retirement and the ones which actually confront him when he is retired.

65 pages. $1.00. Mic 56-1842

PSYCHOLOGY, CLINICAL

THE SELF-CONCEPT AND JUVENILE DELINQUENCY

(Publication No. 16,575)

Raymond J. Balester, Ph.D.
Vanderbilt University, 1956

Supervisor: Professor Ted Landsman

This study represents an attempt to subject certain assumptions of self-concept theory to experimental investigation in order to (1) obtain evidence for or against already existing conclusions by using an experimental context heretofore not used, and (2) amplify present information and data on the self-concept for "normal" and "maladjusted" non-adults aged 12 to 17 years.

The focus of the study, the self-concept, has been operationally considered as the manner in which an individual reflectively aseribes a number of statements to himself.

The Q-technique was the selected method of measurement because it permits a quantification of the self-concept suitable for the statistical manipulations of the study.

This study was divided into three major experimental sections: (1) the investigation of the self-concept as a motivational variable related to observable behavior, (2) the investigation of the consistency of the self-concept as it relates to non-adults and maladjusted non-adults, and (3) the investigation of the sensitivity of the Q-sort

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

self-concept in showing changes resulting from (a) repeated sortings, and (b) institutionalization.

Subjects used in this research consisted of an adult group, a non-delinquent group (ages 12-16 years), and a delinquent group (ages 13-17 years). The delinquent group was comprised of four sub-groups, or types, of delinquent subjects: (1) recently incarcerated first offenders, (2) recently incarcerated repeaters, (3) already incarcerated first offenders, and (4) already incarcerated repeaters.

All groups were administered an originally constructed Q-sort postulatory set three times under identical conditions with a thirty day interval between sortings.

Problem I: Relationship of the Self-Concept to Behavior

General conclusions based on the data of this study are:

1. The Q-sort self-concept scores significantly differentiate groups of subjects with different social behavior patterns, i.e., delinquents and non-delinquents, on the basis of mean positive scores, but not on the basis of positive score variances.

2. The magnitude of the positive Q-sort self-concept score is related to the quality of adjustment. Good adjustment is associated with more positive Q-sort scores than a less effective adjustment.

3. The Q-sort self-concept scores of most individuals, both adult and non-adult, tend to be positive. "Maladjusted" individuals also have positive scores but of lesser magnitude than adjusted individuals. It apparently is relative positiveness rather than positiveness vs. negativeness which is related to adjustment. There is, however, a greater frequency of negative scores among the maladjusted.

4. The positive Q-sort self-concept score can be used to evaluate non-adult adjustment as effectively as adult adjustment.

5. "Normal" non-adults in the age group from 12 to 17 years of age have positive Q-sort self-concept scores similar to "normal" adults.

Problem II: Consistency of the Self-Concept

General conclusions based on the data of this study are:

1. Most individuals possess a significant degree of consistency in their Q-sort self-concepts.

2. Q-sort self-concept consistency does not increase merely as a function of repeating the number of Q-sortings.

3. Q-sort self-concept consistency is not related to the degree of positiveness of the Q-sort score of adult subjects.

4. Q-sort self-concept consistency is significantly related to the degree of positiveness of the Q-sort self-concept of the non-adult.

5. The adult self-concept is significantly more consistent than the non-adult (delinquent or non-delinquent).

6. The non-delinquent self-concept is no more consistent than the delinquent self-concept when all the delinquents are considered as a group.

Problem III: Changes in the Self-Concept

General conclusions based on the data of this study are:

1. Most incarcerated delinquents show no more significant increase in positiveness of Q-sort self-concept scores than non-delinquents or adults over a 60-day period.

2. Repeated sortings do not result in any significant overall increase in the positiveness of the Q-sort self-concept.

3. Intervals of 30 days between Q-sortings apparently minimize the "learning" of item placement which might accompany repeated sortings.

162 pages. $2.03. Mic 56-1843

GROUP PSYCHOTHERAPY WITH CHRONIC MALE SCHIZOPHRENICS: AN EVALUATION OF THE FREQUENCY OF GROUP PSYCHOTHERAPY SESSIONS AS A FACTOR AFFECTING THE RESULTS OF THE THERAPY

(Publication No. 16,582)

John Beletsis, Jr., Ph.D.
New York University, 1956

The purpose of this investigation was to evaluate the frequency of group psychotherapy sessions as a factor affecting the results of group psychotherapy with chronic male schizophrenics.

The basic hypothesis was that chronic schizophrenics would respond to group psychotherapy and that the extent of change occurring would be a function of both frequency and duration of treatment. It was further hypothesized that the frequency of treatment would be the more crucial factor in effecting change. It was finally hypothesized that the patients subjected to more frequent treatment would respond more immediately and more significantly than those subjected to less frequent treatment, over a given span of time.

Thirty chronic male schizophrenics were selected for this study. They were divided into three equated groups on the basis of age, length of hospitalization and degree of illness.

Group I was seen three times per week in group therapy, over a six month period, for a total of 78 sessions.

Group II was seen once per week in group therapy, over a six month period, for a total of 26 sessions.

Group III served as a control group and received no group therapy during this period.

The nature of the therapy was eclectic although psychoanalytic principles were utilized. The atmosphere was permissive and group members were encouraged to voice their feelings and opinions freely.

To determine the effects of psychotherapy all the subjects were evaluated as to their degree of mental illness prior to the experimental period and re-evaluated at the termination of the experimental period. Pre and post-testing included the Multidimensional Scale for Rating Psychiatric Patients and two projective tests, the Rorschach and Human Figure drawing.

The MSRPP provided a Morbidity score which served as a quantified rating of the degree of mental illness. The two projective tests were also rated as to degree of mental illness on the basis of nine personality characteristics. The differences between the pre and post-treatment Morbidity scores and Projective ratings for the three groups were then examined for statistical significance.

On the Morbidity score data, both experimental groups showed positive change that was statistically significant when compared on the control group.

On the Projective rating data, both experimental groups showed more positive change than the control group but not to the extent of statistical significance.

On data regarding increased participation in Activities both experimental groups showed a considerable increase in activities while the control group showed almost no increase.

On final ratings regarding over-all improvement both experimental groups showed more improvement than the control group. The control group was the only group in which members showed negative change.

Qualitative data included a description and comparison of the development, functioning and progress of the two groups. Case presentations on each subject were also included.

The findings were then compared with those of related studies. The limitations of this study were set forth and suggestions for future research were indicated.

The conclusions drawn on the basis of this study are:

Chronic schizophrenic patients do respond favorably to group psychotherapy.

Group psychotherapy produced statistically significant positive change in the more readily observable aspects of personality and behavior.

The frequency of treatment was not the crucial factor in producing change in the behavior or the more permanent and deeper aspects of personality. The more decisive factors appear to be; the experiencing of group psychotherapy, the individual personality qualities the patient possesses, and the qualities and processes of the particular group of which he is a member.

Group psychotherapy does stimulate chronic schizophrenic patients out of their apathy and withdrawal into more social participation and meaningful hospital activities.

240 pages. $3.00. Mic 56-1844

A STUDY OF SHADING RESPONSES ON THE RORSCHACH INK-BLOT TEST

(Publication No. 16,503)

Samuel J. Benveniste, Ph.D.
University of Pittsburgh, 1956

This study was undertaken to investigate some of the possible determinants of a group of responses on the Rorschach ink-blot test: the shading responses. The original problem stemmed from the fact that, while all individuals taking the test might be expected to react to the shading components in the stimulus cards, there seems to be wide variation in the frequency with which such responses are actually encountered. The main assumption which was advanced stated that the frequency of these responses might possibly be determined for a threshold for the shading characteristics of each ink-blot. The absolute value of this limen might presumably depend on many variables. However, on the basis of certain theoretical considerations presented in the dissertation, it appeared that one important factor might be the amount of stress which each individual had experienced before taking the test. This study was then directed, mainly, at ascertaining whether there was any basis for supposing the existence of these thresholds and the effect that stress might have upon them. These relationships were to be inferred from the change in frequency of shading responses brought about by varying the amount of actual shading in photographic reproductions of two Rorschach cards and by subjecting some of the subjects to a previous stress situation. Other hypotheses were suggested while designing the experiment; they concerned the effect (1) of individual differences, (2) of previous experience with ink-blot stimuli, and (3) of the order of presentation of the various intensities of the reproductions.

Sixty students in Introductory Psychology classes at the University of Pittsburgh were assigned in equal numbers at random to a control and an experimental group. All subjects were required during the first session to recite ten lines of poetry after having read them aloud five times. The number of errors made in the recitation was recorded. All subjects were then shown three photographic reproductions of cards IV and VI of the Rorschach test. These reproductions varied in the amount of shading within the ink-blots. All possible orders of presentation of these pairs of reproduction were used. The second testing session was conducted in an identical manner, except that the experimental group was subjected to delayed speech feed-back during the learning and recitation of the poetry. The data were analyzed by means of analyses of variance and covariance.

Evidence was obtained to the effect that delayed speech feed-back had disrupted serial learning. It was found that the frequency of shading responses was dependent, in part, upon the total number of responses furnished by the subject. While individual differences were a significant factor, the amount of experience with the reproductions did not seem to affect the number of shading responses. While stress affected overall productivity when individual differences were controlled, it appeared to have no effect upon the frequency of shading responses. There was no evidence to support the supposition that thresholds, as defined for this experiment, were operative. However, the actual mechanics of stimulus presentation seemingly led to significant differences in shading responses. It was concluded that a "set" occurring on the first presentation of the stimulus material determined the number of shading responses on subsequent presentations.

143 pages. $1.79. Mic 56-1845

THE EFFECTS OF PERSONAL ADJUSTMENT COUNSELING UPON THE REALITY OF VOCATIONAL CHOICE

(Publication No. 16,586)

Hyman Manasseh Chernow, Ph.D.
New York University, 1956

This investigation proposed to study the effects of a personal counseling process upon the preception of reality and fantasy vocational preferences as these related to reality of actual vocational choice, and to the relationship between the suitability and appeal constructs of the self.

It was hypothesized that after personal adjustment counseling: the incidence of reality preferences would increase and fantasy elements decrease; reality of actual vocational choice would be increased; and the relationship between the constructs of the suitability-self and the appeal-self would tend towards congruence rather than discrepancy.

The study population consisted of twenty Korean veterans ranging in age from 20 to 26 years who underwent vocational counseling in guidance centers under contract to the Veterans Administration. The experimental group comprised ten subjects rated unrealistic in vocational choice who were judged to have emotional and personal problems that interfered with vocational decision-making. This group received a planned course of personal counseling that was eclectic in nature, and which ranged from ten to twenty interviews with a mean of 16.2 interviews.

The control or 'base-line' group consisted of ten subjects who differed from the experimental group in their: reality of vocational choice; ability to decide on final vocational objectives; and in relative freedom from emotional and personal involvement. This group did not receive personal adjustment counseling nor post-testing procedures. The experimental and control groups were equated as to age, education, and intelligence. No significant differences were found between the two groups in relation to these factors.

Both groups were selected and referred by vocational counselors who rated their reality of actual vocational choice with an instrument known as the Counselor Rating Scale of Reality of Vocational Choice. The intelligence level of the two groups was equated by the Otis Self-Administering Tests of Mental Ability, Higher Examination: Form B. The incidence of reality and fantasy preferences was measured by a modification of the Q-sort known as the Reality and Fantasy Q-Sort.

The Q-sort was designed to elicit self-ratings of suitability and appeal in relation to vocational preferences. It was administered to the control and experimental groups at the outset of personal adjustment counseling, and at the tenth interview and post-personal counseling stage to the experimental group.

The experimental subjects were rated on degree of movement in personal counseling with the Case Rating Scale. The first rating was at the fifth interview, and the final rating was at the completion of personal counseling. The subjects were rerated on reality of vocational choice at the completion of personal counseling by their original vocational counselors using the counseling record plus supplementary data.

The following conclusions were offered as a result of this investigation:

1. No statistically significant differences occurred between the experimental and control groups at the outset of personal counseling in relation to reality and fantasy preferences on either the suitability-self or appeal-self Q-sorts.
2. The experimental group, after personal adjustment counseling, showed statistically significant increases in reality preferences on the suitability-self sort, but not on the appeal-self sort.
3. A statistically significant congruence was found between the constructs of the suitability-self and the appeal-self in the experimental group at the outset which was reduced significantly at the completion of personal counseling.
4. Statistically significant increases in reality of vocational choice occurred in the experimental group after personal adjustment counseling.
5. A statistically significant association was found between improvement in personal adjustment and final status reality preference scores.

This investigation has demonstrated that personal adjustment counseling can aid a group of emotionally conflicted subjects rated unrealistic in vocational choice to reconstruct certain concepts and values of themselves in the direction of more realistic vocational goals.

320 pages. $4.00. Mic 56-1846

AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN MOTHERS' ATTITUDES TOWARD CHILD-REARING AND CHILDREN'S EXPERIENCES OF THOSE ATTITUDES

(Publication No. 16,611)

Norris Eli Fliegel, Ed.D.
New York University, 1956

Chairman: Professor Brian E. Tomlinson

The purpose of this investigation was to study the child-rearing attitudes and practices of two groups of mothers who had reared their children under highly differing conditions of maternal domination and permissiveness and the manner in which their children experienced those attitudes and practices.

It was hypothesized that the dominated children would deny the extent of the maternal control exerted over them when questioned directly, whereas the self-regulated children would accurately report their home experiences; that the dominated children would express their resentment of their mothers in projective situations; and that both groups of children, each having been reared consistently, would assume their mothers' attitudes toward child-rearing for themselves.

The literature revealed that maternal attitudes and practices within the parent-child relationship are highly influential in shaping the child's personality development, but there was disagreement as to the consequences of specific child-rearing techniques.

To test the hypotheses described above, an attitude scale of one hundred forty-four items pertaining to child-rearing procedures, in the form of general and stereotyped statements, was administered to each mother. Each mother was interviewed and also completed a questionnaire in order to determine her child-rearing practices. A direct interview was carried out with each child to determine his experiences within the mother-child relationship and to investigate his own attitudes in this area.

The results of the above procedures were subjected to appropriate statistical and qualitative analyses.

The population consisted of forty-seven mothers from several Westchester County, New York, communities and their children. Twenty-four mothers had reared their children under conditions of maternal domination and twenty-three had reared their children under conditions of significant self-regulation. The mothers were equaled in terms of age and education. The homes were socio-economically above average.

The children were native-born, between the ages of six and nine, and at least of average intelligence. Both mothers and children were essentially normal subjects, as those with severe adjustment difficulties were not considered in this study.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

The minimum criterion for statistical significance was the .05 level of significance. The chi-square technique was used to establish that significant differences existed between the two groups of mothers with respect to eighty-six items on the Attitude Survey. A high relationship was found between dominating child-rearing practices and dominating child-rearing attitudes. When the attitudes of the two groups of mothers in this study were compared with those of mothers of schizophrenic males, the latter's attitude toward children and child-rearing were more hostile and derogatory.

When the areas of feeding, sleeping, cleanliness, punishment, education, sex, recreation, children's relationships with peers, and children's relationships with adults were considered separately, only in the area of sleep did both groups of mothers deviate from their over-all practices of domination or permissiveness.

When the statements of the mothers and their children concerning home situations were compared, it was found that the pairs (mother-child) in both groups were in high agreement as to what had taken place in the mother-child interaction, refuting the first hypothesis concerning the need of dominated children to deny the extent of the maternal control. A comparison of the two groups of children on a projective technique (Blacky) failed to reveal significant differences in the way which the children appeared to experience the mother-child relationship, both groups feeling understood and accepted. The only point that differentiated the two groups significantly was that dominating children inhibited direct expressions of anger when receiving punishment from adults.

The third hypothesis, concerning acceptance of parental attitudes, was borne out by this study.

174 pages. $2.18. Mic 56-1847

THE EFFECT OF THE "THREATS" OF FAILURE AND DISAPPROVAL UPON THE CONCEPTUAL LEARNING PERFORMANCE OF HOSPITALIZED MENTAL PATIENTS

(Publication No. 16,518)

Herbert John Maginley, Ph.D.
University of Pittsburgh, 1956

Evidence from the more recent investigations dealing with learning performance and conceptual ability in schizophrenics suggests that the impairment usually observed in these patients may be partly a function of their reaction to environmental "threats." Situations presenting the possibility of failure, or the possibility of incurring disapproval, in particular, are thought to be considerably more threatening to the schizophrenic than his normal counterpart. According to one view, individuals tend to equate failure with disapproval, disapproval being considered the primary threat. The evidence in support of these views, however, is not conclusive. The present study was therefore undertaken to investigate further the effects of these variables upon the conceptual learning performance of schizophrenics.

In comparison with the normals, it was predicted that the schizophrenics would (1) have the lower mean performance, (2) experience a greater deficit in performance under "threat of failure," (3) experience a greater deficit in performance under "threat of disapproval," and (4) would experience a greater deficit under "threat of disapproval" than under "threat of failure."

The 2 x 2 x 2 factorial design employed in this study permitted the comparison of schizophrenic vs. normal performance under four different conditions of reinforcement. Four experimental groups, each consisting of 10 hospitalized male schizophrenic patients, were closely equated for mean age, education and vocabulary scores with four normal control groups, each consisting of 10 hospitalized medical patients. Each of the experimental and control groups performed under one of the four conditions of reinforcement. Under the conditions designated 1A and 2A, correct responses only were reinforced; in the case of 1A by the illumination of a white bulb, and in the other by a verbal "Good." Under the conditions designated 1AB and 2AB reinforcement was given for both correct and incorrect responses. Correct responses were reinforced as in 1A and 2A; the reinforcement for incorrect responses consisted of the illumination of a blue bulb, and a verbal "No Good," respectively.

The learning materials consisted of a randomly arranged series of 54 wooden blocks of various sizes, shapes, and colors. Divided into two parts, the learning task consisted of a height-discrimination problem. In part 1 (the "pre-trials") the subject had to learn the concept "X" = tall blocks. In part 2 (the "reversal" trials) the subject was required to make a reversal shift in that this time the short blocks were reinforced as the "X's." The blocks were presented singly for a total of 108 trials on each part.

The main results and conclusions were as follows:

1. The overall comparisons of the conceptual learning performance of schizophrenic and normal subjects revealed consistent, but insignificant differences in favor of the normals. It was therefore concluded that in the case of relatively acute, "undeteriorated" schizophrenics, there is probably no real loss of conceptual learning ability.
2. Both schizophrenic and normal subjects did significantly poorer under the reinforcement conditions that supposedly presented a "threat." No significant differences were found, however, with regard to schizophrenic vs. normal performance. It was, therefore, concluded that schizophrenics are no more vulnerable to mild threats, such as used in this study, than are normals.
3. It was predicted that a comparatively larger deficit in schizophrenic performance would be obtained under a threat of disapproval. This prediction was not supported.
4. The verbal reinforcement was significantly more effective with the schizophrenics than that given by visual cues. The level of performance of the visually reinforced schizophrenic groups dropped significantly on the reversal trials. This was accounted for in terms of diminishing interest and attention. The performance of the verbally reinforced schizophrenic groups was very similar to that of the normals. It was concluded that, with proper rapport, "undeteriorated" schizophrenics can do as well as normals on a conceptual learning problem.

47 pages. $1.00. Mic 56-1848

A STUDY OF RESISTANCE DURING PSYCHOTHERAPY

(Publication No. 13,766)

Roger Marcus Mick, Ph.D.
University of Colorado, 1955

Supervisor: Professor Victor C. Raimy

The first aim of the present study was the development of a rating scale for measuring resistance during therapy interviews. The second aim was an attempt to provide a partial answer to the question: What variables are significantly related to the occurrence of resistance during psychotherapy? The major hypothesis investigated was that patient resistance during psychotherapy is a function of patient personality and biographical variables. Eight sub-hypotheses were advanced which attempted to predict measures of resistance during the initial phase of psychotherapy from measures of patient defensiveness.

The patients studied were thirty-four male veterans who entered psychotherapy from May through October, 1954 at the Veterans Administration Mental Hygiene Clinic, Denver, Colorado. They were consecutive first admissions during the six-month period, were between ages twenty and fifty, were diagnosed as having a psychoneurosis or character disorder, and were scheduled for relatively intensive individual psychotherapy.

Of the four experienced staff therapists who participated, two are social workers, and two are clinical psychologists. No attempt was made to "study the therapists" in this study, but wide individual differences were noted in their personalities and approaches to therapy.

The following test battery was administered to patients individually prior to therapy: a modified version of the F (Fascism) Scale, the Hildreth Feeling and Attitude Scales, a Self-rating Scale, and the K-Scale from the MMPI.

A rating scale was constructed which classifies specific resistance behaviors into four categories according to directionality, as follows: I. Resistance directed against the therapy process; II. Resistance directed against the therapist; III. Resistance directed against admitting psychological problems; IV. Resistance directed against discussing admitted psychological problems.

Resistance ratings were made by the therapist for each patient beginning with the first treatment interview and extending through the first six interviews. A total of 204 rating scales were completed. The ratings were estimates of the time-per-hour spent in resistant behavior. These resistance-times constituted the basis for three criterion measures: (1) estimated total resistance-time; (2) estimated resistance-time classified by directionality; (3) change in amount of resistance-time. A fourth criterion measure was number of interviews attended.

Measures of inter-rater agreement were obtained after the four therapists listened to twelve recorded interviews. The over-all average per cent agreement within ten minutes for rater pairs combined and the five resistance-time scales combined was 75.5 per cent. Measures of intra-rater agreement were based on ratings made after actual interviews and a week later after listening to the respective recorded interviews. For two therapists, the average per cents of agreement within ten minutes on the five resistance-time scales were 76.5 per cent and 96.6 per cent, respectively.

The set of defensiveness measures and the set of biographical variables were uncorrelated. Therefore, the two sets of predictor measures were independent. Correlations within the set of resistance criterion measures indicated that independence obtained for some of them.

Results from the investigation of eight sub-hypotheses about defensiveness and resistance indicated that two correlations between the Attitude Scales and resistance were significantly different from zero.

Results from the investigation of relationships between biographical measures and resistance measures showed five correlations were significantly different from zero.

Because the correlations obtained were low, and because cross-validation and validity generalization studies have not been performed, the question of predicting resistance from initial measures of patient variables was deferred.

The following conclusions were drawn:

1. Only partial support was found for the hypothesis that resistance is a function of patient variables.
2. The specific forms of resistance manifested and the changes or lack of changes in resistance that occur during the first six interviews are a function of the extent to which patients deny negative feelings toward other people, of their educational and occupational levels, and of their verbal ability.
3. Further research is necessary before adequate predictions of resistance can be made.

217 pages. $2.71. Mic 56-1849

SOME PSYCHOLOGICAL CONCOMITANTS OF TUBERCULOSIS AND HOSPITALIZATION

(Publication No. 16,644)

John Francis Muldoon, Ph.D.
University of Maryland, 1956

Supervisor: Professor Thomas G. Andrews

This research was planned to study some psychological concomitants of tuberculosis and hospitalization. The variables included in the study were defensiveness, dependency, anxiety, repression, and rigidity. Subjects for the study were selected on the basis of rigorous criteria so that they would be as similar as practically possible in terms of age, education, and sex. It was hoped that a rigid selection would prevent the results from being masked by extraneous variables which an uncritical selection might introduce.

The subjects were 80 young, white, hospitalized males who were divided into four groups of 20 patients each. Two of the groups were tuberculous; two were nontuberculous. One tuberculous group and one nontuberculous group were made up of patients who had been in the hospital less than three months. The two remaining groups, one tuberculous and one nontuberculous, had been in the hospital more than eleven months.

The data were analyzed by analysis of variance technique, which permitted the effects of illness and hospitalization to be studied independently. It also permitted the observation of any possible interaction effect of illness and hospitalization. The five variables were used in a

regression analysis to determine the relative contribution of each to the differentiation between tuberculous and nontuberculous subjects.

The following conclusions were drawn from the results:

1. There is no evidence of any effect of hospitalization on the psychological variables included in this study.
2. The tuberculous subjects are significantly more dependent and anxious and less defensive than the nontuberculous subjects.
3. The observed differences in the psychological variables between the tuberculous and nontuberculous subjects are attributable to a more fundamental difference in dependency: the tuberculous subjects are significantly more dependent than the nontuberculous subjects.
4. A basic dependency conflict is a possible contributing factor to the development of tuberculosis.

51 pages. $1.00. Mic 56-1850

A TENTATIVE APPROACH TO THE CLASSIFICATION OF CHILDREN'S BEHAVIOR PROBLEMS

(Publication No. 16,562)

Gerald Roy Patterson, Ph.D.
University of Minnesota, 1956

A model was suggested for specific application to the classification of children's behavior problems. The data and its analysis constitute a partial solution of this model.

It was proposed that classification should be made on the basis of observed behavior rather than upon estimates of underlying dynamics. A one hundred and forty-nine item check list was constructed. This check list was used to collect observations made by psychologists while testing children referred to three child guidance agencies. Four children were tested by a psychologist while three judges observed and filled out check lists. This partial assessment of reliability indicated that agreement between judges is sufficient to warrant use of this type of check list in collecting data.

As a partial control for the effects of the variables of intelligence, age, sex, brain syndromes, only the following types of cases were utilized in the sample: One hundred male children ages seven through twelve, with IQ's above eighty, not having been identified as being brain damaged. Information for these cases as to referral symptoms was also recorded.

The matrix of one hundred and forty-nine behavioral items and thirty-eight symptoms was factored by the Wherry-Gaylord technique of deriving factors from large pools of items. The factors obtained were: I Withdrawal, II Hyperactive, III Immaturity, IV Aggression, V Anxiety. Correlations between these primary factors ranged from -.497 to .113. Correlations between factors of this magnitude indicate that they are not orthogonal. It should be noted that item construction has some influence on relationships between obtained factors; quite possibly the nature of the items in the check list contributed to the high negative relationship between factors. Two judges independently labelled the factors with a high degree of agreement. Two additional judges matched these labels with the factors with one hundred percent accuracy.

It was the contention of this writer that it is not the descriptive factors derived above which constitute categories for classification. Classification should not be made on the basis of a position on a single factor, but should take into account the relative position of a patient on all of the descriptive factors. A transposed factor analysis, in which the matrix is composed of the correlation between individuals on their factor scores, was a suggested method of deriving the classification categories. The last step of the transposed analysis was not undertaken. It is felt that the descriptive factors necessary for such an approach should be the result of analyzing several samples of patients with several different check lists.

The factors obtained in this study were tested for their ability to discriminate between patients. A group of twenty-four aggressive and fifteen withdrawn children were selected on the basis of presenting symptoms by two clinicians. Using the linear discriminant function, the multivariate means of the combined factors were able to discriminate between these two groups with an accuracy of 80% for the withdrawn group, and 87% for the aggressive group. This would seem to indicate that if categories could be derived the appropriate factor weights for assignment to each category could be calculated. Classification would then be a matter of rating a patient on observed behavior, obtaining his position on each of the descriptive factors and, using a linear discriminate function, assigning him to the proper category.

196 pages. $2.45. Mic 56-1851

CHANGES IN THE STRUCTURAL ASPECTS OF PERCEPTION IN THE AGED: AN ANALYSIS BY MEANS OF THE RORSCHACH TEST

(Publication No. 16,744)

Herman Rochwarg, Ph.D.
Michigan State University, 1954

The purpose of this research project was to investigate one aspect of the psychological functioning of the aged; namely, the structural aspects of this group's perception. A review of the literature suggested that there is an involution of this perceptual process which parallels the decline noted in physiologic processes, sensory and motor functioning, intellectual abilities, and over-all psychological functioning of this group.

As a test of this general hypothesis, the Rorschach responses of two groups of subjects were analyzed: (1) a group of forty normal aged between the ages of 68 and 91; and (2) a group of forty normal adults between the ages of 23 and 45. None of the aged subjects were bed patients or convalescents. All were relatively active, either in the community or in the home in which they resided. The adult subjects were either government employees or held jobs in various industrial organizations.

The specific hypotheses stated the following:

1. The aged group, being characterized by a general biological involution, would show less evidence of integrative perceptual activity than the adult group.
2. The aged group would show more evidence of early thought processes than would the adult group.

The Rorschach responses of these two groups were analyzed in terms of developmental level, using an index

of integrative perceptual activity and an index of primitive thought processes.

Both hypotheses were confirmed by the results. The aged group scored significantly lower on the Index of Integration, and significantly higher on the Index of Primitive Thought.

In the discussion of the results, three main points were stressed:

1. Senescence is a developmental phase characterized by its own unique psychological structure.
2. Perceptual decline in the aged is marked by considerable individual variation.
3. The indices of developmental level used in this investigation could be appropriately employed to evaluate the "psychological" age of elderly individuals.

90 pages. $1.13. Mic 56-1852

THE USE OF GROUP THERAPY IN A COUNSELING PROGRAM WITH PARAPLEGICS: A COMPARATIVE STUDY OF THE EFFECTS OF THE INCORPORATION OF GROUP THERAPY IN A COUNSELING PROGRAM ON THE BEHAVIOR AND CERTAIN ATTITUDES OF PARAPLEGICS

(Publication No. 16,601)

Robert Howard Rossberg, Ph.D.
New York University, 1956

Chairman: Professor Roland Spaulding

The purpose of this study has been to investigate the effect of the incorporation of group psychotherapy into a counseling program with paraplegics. Accordingly, two groups of patients were studied at the Institute of Physical Medicine and Rehabilitation of the New York University-Bellevue Medical Center. One group participated in the routine counseling program and received individual counseling only. The other group also participated in the routine counseling program and received individual counseling in addition to participation in a series of twelve structured group therapy sessions. The subjects were studied during two separate experimental periods of six weeks duration to eliminate the effect of one group on the other.

All the subjects were rated at the beginning of the experimental period by the psychologist, physician, nurse, occupational therapist, physical therapist, specialist in activities of daily living, and a projective technique, the Berger Sentence Completion Test, was also administered. The ratings were repeated at the conclusion of each experimental period.

The preliminary ratings of each group were all positively correlated with each other with coefficients of correlation computed by means of the Spearman rank-order method. The median coefficients of correlation on each measure ranged from .57 to .78 and were considered to be on a significantly high enough level to be reliable measures of the two groups.

There were no significant differences between the groups on any of the seven variables used as measured by the Chi Square Median Test.

The basic hypothesis of the study predicted that there would be significantly greater change in the group which received both individual and group therapy as compared with the group which received individual therapy alone. A one-tailed test of significance was used since the data of this study met all the requirements for the application of such a test including an a priori hypothesis, more plus than minus signs, and z scores on each of the variables which exceeded 1.645. The hypothesis was upheld at greater than the .05 point of significance on three of the variables (psychologist's and nurse's ratings, and the projective technique) and at greater than the .10 point of significance on a fourth variable (occupational therapist's ratings).

No significant differences were found between the groups on the other three variables although a trend in the direction of the hypothesis was noted in the ratings by the physician and the specialist in the activities of daily living.

The results indicate, as far as the population under study is concerned, that group therapy which is structured in nature, in terms of providing information and the opportunity to discuss that information, can be effectively utilized in a "nonvoluntary" counseling program with paraplegics. The counseling program for paraplegics at the Institute of Physical Medicine and Rehabilitation was made more efficient by the addition of structured group therapy with significant improvement noted in such "unstructured" activities as individual counseling, prevocational exploration, and certain attitudinal changes as reflected by improved behavior on the wards and in response to a projective technique. The addition of the group therapy program did not seem to make a significant difference in the behavior of patients in "structured" activities such as organized physical therapy and activities of daily living.

The results and conclusions of this study indicate that current techniques in counseling and guidance in rehabilitation can be improved by careful evaluation of existing techniques and controlled experimentation with new techniques particularly in the relatively new area of group psychotherapy. 209 pages. $2.61. Mic 56-1853

PSYCHOLOGY, EXPERIMENTAL

THE PERFORMANCE OF NEURO-MUSCULAR RESPONSE UNDER VARYING NOISE CONDITIONS: AN INVESTIGATION OF THE RELATIONSHIP OF NOISE, OF VARYING INTENSITY AND FREQUENCY, TO SELECTED NEURO-MUSCULAR RESPONSES WITH IMPLICATIONS FOR SAFE WORK PERFORMANCE AND OTHER PRODUCTION FACTORS

(Publication No. 13,611)

John V. Grimaldi, Ph.D.
New York University, 1955

A review of the literature dealing with the effects of sound upon human performance indicated a paucity of conclusive evidence. Studies reported generally are to some extent incomplete and contradictory.

The present study was concerned with the relationship between sporadic noises and the performance of neuro-muscular responses, a topic considered of particular

interest from the aspect of safety. For practical purposes the experimental activity feigned the operation of a compound slide rest such as would be used on an engine lathe and the experiment was designed to motivate participance toward a rapid, accurate and productive completion of the assigned task.

The experimental noises were produced within the frequency bands: 75-150, 150-300, 300-600, 600-1200, 1200-2400, 2400-4800 and 4800-9600 cycles per second. Each noise was recorded indentically on tape three times at 70, 80, 90 and 100 db.$\pm$ 1 db.(re: 0.0002 dyne/sq. cm.). The bursts of sound ranged from 9 to 23 seconds duration. The total time that the initial sound and its two repetitions were heard, was 45 seconds. Interspersed between each burst of noise was a quiet period varying from 2 to 13 seconds, with a three minute quiet spell midway in the recording. The full fime of the recording was 28.8 minutes.

Subjects were delimited with respect to age, hearing and vision acuity. Participants who had taken alcohol, overindulged in food, had not had their regular amount of sleep or who complained of not feeling "up to par" were culled. The environment was delimited with respect to relative humidity and illumination. There were fifty-two participants - fourteen men, thirty-eight women; eight experienced with the operation of the compound slide rest type of apparatus, forty-four inexperienced. The experimental activity required a coordinated movement of a stylus around a pattern by turning two crank handles. Each participant was indoctrinated by reading an instruction sheet and practicing for ten minutes; he was then tested and retested until the scores for three succeeding tests were approximately identical. The experiment consisted of operating the test apparatus during exposure to the recorded experimental noises and while exposed to the quiet conditions of the room (37 db.). The run for each test (noise and quiet) was of the same duration (28.8 minutes) with a ten minute rest between. Data were recorded on instruments through the making and breaking of an electric contact as the compound slide rest stylus was guided accurately or inaccurately around the prescribed pattern. A tracing of the pattern was obtained by means of a "pantograph-type" attachment to the stylus. Data were collected for the factors: response time, number of errors, productivity, precision, response time per error and errors per unit of production.

A statistically significant relationship was found between intermittent noise and response time and number of errors. Production and precision tended to be reduced in the presence of noise. Exposure to noise in the upper frequencies and at levels of 90 and 100 db. tended to produce slower response times and a greater number of errors.

The following broad suggestions may be made:

1. Where sound levels exist that are greater than 90 db., and particularly in the case of sounds which are dominant in the frequencies above 2400 cycles per second, consideration should be given to the application of acceptable procedures for reducing the sound level at the individual's ear.
2. Further research should be undertaken to follow up the suggestive clues identified in this exploratory investigation.

224 pages. $2.80. Mic 56-1854

SOME METABOLIC CORRELATES OF AMENTIA AND DEMENTIA: A COMPARISON OF THE PHYSICAL, METABOLIC AND PSYCHOLOGICAL MEASURES OF CHILDHOOD SCHIZOPHRENICS, MENTAL DEFECTIVES AND NORMAL CHILDREN, AND THE EFFECT OF GLUTAMIC ACID THERAPY UPON THESE RELATIONSHIPS

(Publication No. 13,617)

Marvin Laurence Head, Ph.D.
New York University, 1955

Chairman: Professor John Rockwell

A research was designed for the purpose of testing the efficacy of glutamic acid therapy on three groups of children. Childhood schizophrenics, mental defectives and normal children between the ages six and twelve years were randomly divided into placebo and experimental groups. A further group served the purpose of an inactive control, and provided test-retest records against which to compare the performances of the therapy-placebo groups. Ninety children were involved in the design. Tests were given upon initial admission to the study. At this point, half the active group began taking eight grams of placebo daily. The remainder took eight grams of glutamic acid. After thirty days, the placebo groups were changed to glutamic acid and vice versa. After an additional thirty days, they returned to their original experimental conditions, under which they were maintained for the last thirty days. The total therapy-placebo phase embraced a ninety-day period. Subjects were reevaluated monthly, once each at their initial admission to the study, after thirty days, sixty days, and at termination.

Results indicated little effect of glutamic acid therapy on the normals. Projective tests failed to indicate reliable changes and psychiatrists were unable to separate the glutamic acid groups from the control groups. However, the difference in intelligence test scores between initial and reevaluation performances was significantly greater for the glutamic-acid-fed schizophrenics and mental defectives than for either placebo or inactive controls. No such differences occurred in the normal groups.

It is concluded that a suggestive beneficial effect of glutamic acid on pathological states has been demonstrated.

227 pages. $2.84. Mic 56-1855

AVOIDANCE LEARNING OF DISCRIMINATION PROBLEMS BY THE MONKEY

(Publication No. 16,514)

Thomas Owen Jacobs, Ph.D.
University of Pittsburgh, 1956

Two groups of naive Rhesus monkeys were trained on the Wisconsin object quality problem to avoid a mild electric shock for errors, but without food for correct responses. The animals were motivated to respond in this situation by a mild intermittent shock which was administered when the animal failed to respond over a period of eight seconds after the stimulus tray was presented.

Of the two groups so trained, one was run under a procedure which required that the animals correct their incorrect choices (correction method) and the other under a procedure which required that they not correct (noncorrection method). After five blocks of 96 problems each, two animals from each group were placed on extinction for three additional blocks while the remaining animals were continued for three blocks on the avoidance procedure.

The results of the experiment therefore permitted three comparisons. The first of these was a comparison of the rate of learning set formation under avoidance conditions with a previously established rate found in the same apparatus under food-reward conditions. The second was a comparison of training methods within the avoidance procedure, and the third was a tentative comparison of the relative ease with which avoidance responses are extinguished in terms of complexity of task.

Briefly, the most important result of the experiment is that these two groups of animals as groups learned to learn three-trial discriminations more and more efficiently over successive blocks of problems. The range of final mastery of the problem on an individual basis was from a performance superior to that of all the animals of the food-reward control group to a performance which was no different from chance. When compared with food-rewarded animals, the animals of the present experiment learned much more slowly and to a considerably lower final level of achievement. A further, but tentative, conclusion was that shocked animals tended to make more perseverative errors than food-rewarded animals.

The two training-methods groups were very similar in performance, differing only in that the animals in the noncorrection group were more variable than the animals in the correction group.

No animals extinguished during the three blocks of extinction problems. To the contrary, two extinction animals, those with superior pre-extinction achievement, actually increased their accuracy of choice over the first block of extinction problems and declined over the remaining two blocks only to a level approximating their performances on the last avoidance block.

These results were discussed in terms of the influence of preliminary training methods on later learning. Specifically, it was hypothesized that the preliminary training procedures in this situation produced a conflict in the object-quality phase between decision-making behavior and object-moving behavior. This, in turn, was hypothesized to have made the object-quality problem difficult for some animals because they, in essence, had learned to respond instead of first to choose and then to respond. It was suggested that this orientation might prove to have value in explaining the results of many reported studies in which unpredicted results were obtained.

112 pages. $1.40. Mic 56-1856

THE EFFECTS OF INTER-TRIAL SPACING AND OF STIMULUS VARIABILITY ON VERBAL CONDITIONING

(Publication No. 16,555)

David Kalman, Ph.D.
University of Minnesota, 1956

Each of 20 college students was run through two successive sequences of 120 trials per sequence in a verbal conditioning experiment. A random sample from 12 independently controlled lights on a panel was the signal, or conditioned stimulus, on any trial. The probability that any light would be on was approximately 1/3 for one experimental group and 3/3 for a second group for the first 120 trials. These probabilities were reversed for the two groups for the second 120 trials. The reinforcing stimuli, or unconditioned stimuli, were two lights located immediately in front of the subject. The task of the subject was to predict which of the two reinforcing lights would appear on a trial following the presentation of the signal. The subject indicated his prediction by pressing one of the two telegraph keys located beneath the reinforcing lights. One of the two reinforcing lights was randomly designated E_1 for each subject. During the first 120 trials, E_1 occurred with a probability of .25 for all subjects, and, during the second 120 trials, with a probability of .65 for all subjects. The E_1s and E_2s appeared in a random order. Experimental subjects were also assigned to two different inter-trial time intervals which were kept constant throughout both trial sequences. The first interval was 0.4 sec. and the second was 2 sec. in duration.

These procedures were instituted in order to test the four predictions indicated below. These predictions were generated by a statistical theory of learning, and the first two were previously tested by Burke, Estes, and Hellyer (1) using a different probability of reinforcement. The predictions were as follows:

1. When the number of trials is sufficiently large, the cumulative frequency of the less frequently reinforced response is inversely related to the magnitude of the signal probability.
2. When the learning curve is plotted in terms of the relative frequency of a given response per trial block, it approaches an asymptote, the value of which is the probability of reinforcement for the trial sequence.
3. If the signal probability values which have been assigned to two experimental groups are reversed after a sufficiently long sequence of trials, the course of learning in a trial sequence immediately succeeding the first should accord with the above two predictions, provided that the response probability is independent of the signal probability before the reversal occurs.
4. In a stimulus complex consisting of a controlled or conditioned stimulus and an uncontrolled stimulus, the relative weight of the controlled stimulus in the total stimulus complex should increase when the inter-trial time interval is increased.

The following conclusions are suggested:

1. The statistical hypotheses based on Prediction 1 were significant at less than the 5% level of confidence for both sequences, indicating that the learning rate is inversely related to the degree of stimulus variability.
2. Appropriate statistical tests indicated that the learning curves were near the specified theoretical asymptotes for both trial sequences.

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

3. Prediction 3 was confirmed.
4. There was no indication that an increase in the inter-trial time interval increased the relative weight of the controlled stimulus.

Two additional findings may also be cited:

1. There was no statistically significant difference in rate of learning due to the difference in the inter-trial time intervals.
2. The subjects tended to respond to the specific sequence of E_1 and E_2 occurrences and not to the entire sequence taken as a whole.

BIBLIOGRAPHY

1. Burke, C. J., Estes, W. K., and Hellyer, S. Rate of verbal conditioning in relation to stimulus variability. J. exp. Psychol., 1954, 48, 153-161.

125 pages. $1.56. Mic 56-1857

TIME AND SPATIAL PROXIMITY IN THE ORGANIZATION OF PERCEPTION

(Publication No. 16,627)

Jaques Waldemar Kaswan, Ph.D.
Washington University, 1955

Chairman: Dr. Saul Rosenzweig

The primary aim of this study was to investigate the relation between time and spatial organization as exemplified by the factor of proximity. In addition, this study explored the possible impairment of time-space relations in schizophrenics, and attempted to discover analogies between these perceptual functions and broader aspects of cognitive functioning. Using geometric designs which varied the distance between groups (e.g. (h) . . . . . and (d) . . ..) and a concept formation test, the following major hypotheses were proposed:

1. Perception of groupings evolves in time according to a predictable sequence, from homogeneity to differentiation. Thus both (h) and (d) above will be seen as lines of dots (without grouping) if exposure time is sufficiently reduced in a tachistoscope.

2. When spatial relations are such as to maximize structural distinctiveness (e.g. (d) above), the time required for the organizing process is minimal. Where structure is less clear (e.g. (h) above) more time is required.

3. Schizophrenics should require more time to perceive groupings than normal or neurotic Ss but the difference should decrease as structural clarity increases (e.g. (d) above). The performance of neurotics should be between that of schizophrenic and normal Ss, but closer to the latter.

4. (a) Schizophrenics should show more "concrete" concept formation behavior than normals, with neurotics falling between the two groups but closer to the latter. (b) Concrete concept formation should be associated with high time thresholds for the perception of grouping.

Criteria for scoring were determined a priori and with considerable specificity. For instance, only "pairs of dots" or some synonymous description would be accepted as correct for (d) or (h) above.

Concept formation was tested with a Sorting Test, following the procedure and scoring criteria suggested by Rapaport.

The study consisted of a pilot experiment in which designs for the perceptual study were selected and exposure times determined; the main experiment, containing the perceptual and Sorting Test; and a control experiment aimed at establishing the unequivocal presence of groupings in the designs by allowing adequate time for perception.

Twenty-five Ss participated in the pilot experiment, of whom 20 were nurses, attendants, and other hospital personnel, while 5 were schizophrenic patients. The 72 male Ss participating in the main experiment were divided into 3 groups of 24 each: one of Medical and Surgical patients with no known psychiatric complications, one of neurotic patients, and one of schizophrenic patients. Selection was based on chart diagnosis. The groups were about equal in average age, education and intelligence.

The data were analyzed with both graphic and statistical methods to test the predicted trends and differences between groups and between variants of each perceptual design. Pearson r correlations were used to investigate the relations proposed among the various aspects of this investigation.

The results generally support hypotheses 1, 2 and 3. That is, the initial response to most designs at fast exposure times usually described a fairly homogeneous structure, such as "a line of dots," grouping becoming differentiated as time of exposure was lengthened. It thus required less time to see groupings in most (d) than (h) type designs, but contrary to part of hypothesis 3, schizophrenics required more time to see groupings in (d) designs than did the other groups.

Schizophrenics showed more "concrete" concept formation behavior than did the other groups, as proposed in hypothesis 4-a but the results are inconclusive with respect to hypothesis 4-b. Medical and Surgical Ss who did well on concept formation also saw groupings very quickly, or the reverse, whereas no such consistency is apparent for neurotics or schizophrenics.

The findings indicate that perception of groupings develops in time according to a predictable process of organization. Also, the results tend to support the notion that time-bound functions are disturbed in schizophrenics.

105 pages. $1.31. Mic 56-1858

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN DRIVE INTENSITY AND THE GROWTH OF HABIT STRENGTH

(Publication No. 13,771)

Duane Marwin Rumbaugh, Ph.D.
University of Colorado, 1955

Supervisor: Assistant Professor Maurice P. Smith

The present study investigated the effects of high and low hunger drive states during training upon subsequent

extinction and relearning of a simple Y-maze habit. The experimental program consisted of a factorial design in which drive intensity during training, number of training trials, and drive intensity during extinction and relearning were systematically varied. Groups of rats received either 2, 6 or 10 food-rewarded training trials to one side of a simple Y-maze. For these training trials, all of which were forced, one half of the animals was 6 hours hungry and the other half was 22 hours hungry. Measures of habit strength were obtained from subsequent free-choice extinction and relearning trials. For these trials the training groups were equated for drive with half of each group 6 hours hungry and the remaining half 22 hours hungry.

Performance measures obtained from extinction and retraining trials were used to evaluate two hypotheses: (1) that habit strength is an increasing function, within limits, of drive level present during training, and (2) that drive level affects habit strength by determining the growth function for habit, if not the asymptote for habit development. These hypotheses imply, first, that the animals trained 22 hours hungry should develop stronger habit than the animals trained 6 hours hungry regardless of number of training trials. Second, any advantage which might result from high drive during training might diminish as the number of training trials increases from 2 to 10.

The measures of performance from extinction and retraining trials consisted of total number of errors and latencies for running the maze and eating the food reward. Analysis of variance was employed to evaluate the significance of errors accompanying variations in the experimental program.

The results of the experiment are as follows:

1. The effect of drive during training was not detected in the statistical analysis of error scores from extinction. Analysis of error scores from retraining, however, identified drive during training as a significant source of variance. Animals trained 22 hours hungry relearned the appropriate response significantly faster than the animals trained 6 hours hungry.

2. In the groups that received two training trials, the animals that were trained 6 hours hungry made a significantly greater number of errors during retraining than animals trained 22 hours hungry.

3. Analysis of error scores derived from performance during retraining indicates a significant interaction between number of training trials and drive during test (extinction and retraining).

4. There was no indication that learning was enhanced by an increase in number of training trials in this situation. To account for this unexpected result it was suggested that the forcing of all training trials to one arm of the Y-maze might have introduced something analogous to a "place-avoidance" tendency. Further, the suggestion was made that the variable of number of training trials might have produced differential strengths in fractional antedating goal responses which then operated during extinction trials in such a way as to strengthen incorrect as well as correct responses.

5. Analysis of latency measures obtained from training trials indicated no simple or obvious way in which to account for the significant differences in error scores on retraining.

From these data, the following tentative conclusions were drawn:

1. The positive relation obtained between drive level during training and rate of subsequent retraining is in direct support of the first hypothesis, namely, that habit strength is an increasing function, within limits, of drive level during training.

2. Inasmuch as no significant interaction between number of training trials and drive during training was obtained, direct support was not afforded the second hypothesis that concerns the effect which drive level during training might have upon the growth function for habit.

92 pages. $1.15. Mic 56-1859

THE USE OF INSTRUMENTAL MOTOR AND VERBAL LEARNING TECHNIQUES IN THE TREATMENT OF CHRONIC SCHIZOPHRENICS

(Publication No. 16,755)

John R. Tilton, Ph.D.
Michigan State University, 1956

The present study has been an attempt to apply some of the thinking and methodology of instrumental conditioning to the treatment of chronic and withdrawn schizophrenics. The principle objective was to condition verbal approach behavior in those patients who had nearly ceased to use adequate verbalization in coping with the world around them.

Since nearly all patients of this category do demonstrate some ability in carrying out simple motor responses such as walking around the ward, handling eating utensils, smoking, etc., such motor responsiveness seemed to be a good vehicle through which to begin conditioning verbal approach behavior. The method employed was the movement of a lever by the subjects in patterns of increasing complexity until verbalization was a necessary adjunct for arriving at the "correct" pattern of movements. The subjects were instructed and guided both manually and verbally and were rewarded by both candy and praise for successful solutions. Toward the end of the experimental period, simple word games were tried with the subjects using the same rewards. This procedure was compared with a direct "talk to" kind of therapy and also with no treatment at all.

The results of two kinds of ratings (status rating from interviews and improvement ratings by ward personnel) indicated that there was some measureable improvement in four of the five subjects of the experimental group, in two of the five subjects of the "talk to" group, and in only one of the ten subjects of the group which had no specific treatment. There was almost universal agreement among the improvement raters that the language facility of all the experimental subjects had shown some improvement.

Observational results indicated that the subjects who were the most verbal to begin with gained more benefit from the "talk to" therapy while they benefitted very little from the motor therapy. The converse was the case with the mute or nearly mute subjects. The inability of the verbal patient to use adequate verbalization on the motor tasks was interpreted as the result of their responding with behavior that was verbal, but that was antagonistic to anything that might be useful in solving the motor tasks. However in the "talk to" sessions, the examiner could make appropriate responses to the verbal patients and

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achieve communication. Furthermore, it appears that the more nearly mute patients are more amenable to treatment via motor tasks because the degree of their withdrawal reduces the number of incompatible verbal responses.

83 pages. $1.04. Mic 56-1860

RELIGION

THE DEVELOPMENT OF INSTITUTIONAL PROVISION FOR THE CARE OF THE AGED IN THE EVANGELICAL AND REFORMED CHURCH

(Publication No. 16,528)

Albert McClellan Wright, Ph.D.
University of Pittsburgh, 1956

The purpose of this study was to trace the development of institutional provision for the care of the aged in the Evangelical and Reformed Church, which was a merger of two denominations in 1934, from 1725 to 1950. The effort was made to determine to what extent and in what ways during its history in the United States the denomination had given consideration to care of aged ministers and aged laymen.

Answers to such questions as the following were sought: What regard was given to the care of aged people by the Church? When was it started, by whom and how administered? When and under what circumstances did care become organized? What was the nature of the organization? Did it evolve from the "grass roots" or was it imposed by higher denominational judicatories? Did help come from a cooperative effort on the part of those expecting to be benefited or from other sources? What were the steps in the development of the care of the aged from its beginning to the present time?

The historical method of research was used in tracing the development of the care of the aged in the Reformed Church from 1725 to 1934. The same was done with the records of the Evangelical Synod of North America from 1833, the date of its origin in the United States, to 1934. From 1934 to 1950 the study was continued in the united denonination, with due consideration given to funds which had been placed in perpetuity before the merger.

It was found that the institutional development of the care of the aged originated very shortly after the beginning of the Reformed Church. For a few years voluntary contributions by members of the Coetus supported a minister's widow. In 1752 a formal organization known as the "Widows' Fund" was organized. Within ten years aged and infirm ministers also were being supported from the Fund which was subsidized by the Holland Reformed Church until 1790.

There was considerable fluctuation of interest until the organization of General Synod in 1863. The Synod endeavored to guide a denominational program, but lower judicatories in a number of cases developed their own welfare agencies. Competition and rivalries reached such a condition by 1905 that General Synod organized a Board of Pensions and Relief. In the year 1917 the first denominational pension system came into being. During the next decade a number of relief agencies merged.

After the merger of the two denominations in 1934, further unification of pension and relief agencies took place. In 1940 the Board of Pensions and Relief reorganized, making membership of all active pastors mandatory and requiring each pastor to contribute three per cent of his salary in addition to payment by his employer of five per cent of the pastor's salary.

Fourteen homes for the aged were functioning in 1950. Most of them were supported by payment of fees, gifts, legacies, and annual contributions by churches in the Synod wherein the home was located.

A consideration of all the factors involved indicates that responsibility for the welfare of the aged in general developed from the "grass roots" in many different sections of the denomination. At present, subsistence for aged ministers and their families is slowly approaching a livable status. Homes for the aged are the best the denomination has to offer aged lay people, but even these have long waiting lists of applicants and all need considerably more support.

381 pages. $4.76. Mic 56-1861

PREDICTING STUDENTS' PERFORMANCE IN A GENERAL MEDICAL CLINIC

(Publication No. 13,762)

John Robert Davis, Ph.D.
University of Colorado, 1955

Supervisor: Associate Professor Kenneth R. Hammond

This study is concerned with the prediction of the performance of medical students in a new program at the University of Colorado Medical School. This program, featuring extended and comprehensive care of patients, was substituted for six months of the regular senior year curriculum.

Subjects consisted of two groups of students (first to participate in the GMC) selected at random from the 1953-54 senior class. Group I (N = 21) participated in the GMC during the first six months of the senior year, and Group II (N = 18) was in the GMC during the second six months.

The students' performance in the GMC was rated by the GMC staff on 21 variables of two general classes: (1) Medical Skill and Knowledge (MSK), related to the students' problem, and (2) Interpersonal Relations (IPR), related to the students' attitudes and relationships with patients. Prior to their participation in the GMC, 38 predictor scores were obtained for these students. The predictor scores are of 5 types: (1) Medical College Admissions Test Scores, (2) Pre-medical and Medical School Grades, (3) Tests of Medical Knowledge and Understanding of Patients, (4) Measures of Attitudes and Values, and (5) Sociometric Peer Ratings.

The data obtained for each group of students were treated separately in an effort to determine (a) relationships between predictors and criteria, (b) interrelationships among the criteria and the comparability of the ratings for the two groups, and (c) comparability of the two samples of students. Finally, data for each group were submitted to a separate factor analysis.

For Group I, predictor-criterion relationships were meaningful and consistent with expectations. Predictors positively related to MSK ratings were: (1) Pre-medical and Medical School Grades, (2) Medical Knowledge Test, (3) Non-Authoritarianism, (4) Liberal Social Attitudes, (5) Low Religious Interests, and (6) Peer Ratings on Leadership and Good Doctor. Predictors positively related to IPR ratings were: (1) Liberal Social Attitudes, (2) Theoretical Interests, and (3) an Index of Student-Staff Similarity in relation to ideas concerning good doctor-patient relationships. Measures negatively related to IPR ratings were Previous Grades, and Peer Ratings on Leadership and Good Doctor.

Comparable predictor-criterion relationships were not obtained for Group II. Although high correlations, positive and negative, were obtained, they lacked the meaningfullness and logical consistency of the results for Group I. A reasonable explanation of the inconsistencies in the predictor-criterion relationships for the two groups was provided by the results of the factor analyses and the comparison of the students in the two groups.

The factor analysis for Group I revealed two relatively independent criterion factors, differentially loaded on MSK and IPR ratings. These two factors were meaningfully related to the predictor measures. For Group II, all the criterion ratings loaded on a single factor, and this factor had little logical relationship to any of the predictors.

Students in Group I tended to be a superior group of students and provided more variability with respect to certain characteristics which were considered to be important to performance in the GMC. Consequently, it was relatively easy for the staff to differentiate among the students in relation to these characteristics. Group II, being considerably more homogeneous in regard to these same characteristics, provided a more difficult differentiation problem for the staff. Moreover, this group was more variable with respect to Likeability and Cooperation and thus provided a more prominent, although irrelevant basis for evaluation.

Therefore, it was concluded that of the two groups, the results of Group I provided the more valid clues as to important characteristics of the successful GMC student. Furthermore, it was concluded that the study provided empirical data as to certain conditions which were necessary before successful prediction could be achieved.

164 pages. $2.05. Mic 56-1862

MODIFICATION OF ATTITUDES TOWARD THE VISIBLY DISABLED: AN EXPERIMENTAL STUDY OF THE EFFECTIVENESS OF SOCIAL CONTACT IN PRODUCING A MODIFICATION OF THE ATTITUDES OF NON-DISABLED FEMALES TOWARD VISIBLY DISABLED MALES

(Publication No. 16,580)

Jack Granofsky, Ph.D.
Yeshiva University, 1955

A. Problems: (1) To determine, experimentally, whether social contact is an effective procedure for producing a modification of the attitudes of non-disabled females toward visibly disabled males., (2) to determine what relationships exist, if any, between certain psychological and situational variables and attitudes toward the visibly disabled.

B. Methods of Procedure: A controlled experiment was conducted in which 104 newly joined non-disabled members of the Womens' Auxiliary of the 52 Association of New York who had not had any previous intimate contact with the physically disabled were exposed to a period of approximately eight hours of social contact with visibly disabled veterans in two Veterans Administration Hospitals in the New York City Metropolitan area. Attitudes toward various visibly disabled (Wheelchair Subjects,

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Facially Disfigured, Leg Amputees and Arm Amputees) were tested before and after the contact experience, as well as the specific factors that were presumed to have some connection with these attitudes. At the same time an identical battery of tests was administered to a comparable control group of 101 non-disabled women, from outside the 52 Association, who were not exposed to the experimental variable.

C. Sources of Data: (1) Two protective attitudes - a Pictures Test and a Sentence Completion Test - which were specially constructed and evaluated in advance of the experimental study were used for ascertaining the attitudes toward the disabled. The validity of these two tests was established by correlating the scores on the attitudes tests of 58 members of the Womens' Auxiliary of the 52 Association who had had at least a year or more of previous experience with the disabled with the ratings of their demonstrated behavior toward the disabled. Reliability was established by adapting Hoyt's Analysis of Variance Technique. (2) To test for the specified psychological factors the following techniques were employed: Drawing Completion Test; Interest-Values Inventory; Minnesota Inventories of Social Attitudes; P-S Experience Blank, Part I. (3) To ascertain the situational factors a special Biographical Blank was devised.

D. Summary of Findings: (1) Initial Attitudes. On the whole, the pre-experimental attitudes were decidedly negative. It was found, too, that attitudes toward the four different types of disabilities that were sampled in the Pictures Test could be arranged in the following negative to positive rank order: Wheelchair, Facial Disfigurement, Leg Amputees, Arm Amputees. Similarly, on the Sentences Completion Test, attitudes toward the general orthopedic disability were decidedly more favorable than attitudes toward the facial disfigurement. (2) Result of the Experiment: Comparisons of the test-retest data indicated that social contact is not an effective procedure for modifying underlying hostilities toward the physically disabled. While there was a slight tendency for the attitudes toward the facial disfigurement to improve, and a stronger tendency for the group to become more homogeneous after the contact experience, the overall picture showed little fundamental movement in a positive direction. Moreover, a special analysis of the influence of the duration of the contact experience showed that the time allowed for the experimental variable was of no consequence in producing this negative result. (3) No significant relationships were demonstrafed between the various personality and background factors selected for study and attitudes to physical disability, indicating that these negative attitudes are most likely a universal feature of contemporary group life.

E. Conclusions: The most important impression gained from the study is that attitudes toward the disabled are highly resistant to change regardless of the particular change variable employed. This finding would seem to point up the need for improving rehabilitation facilities for the disabled themselves. Nevertheless, it would still seem to be just as important to continue to try to change the hostile attitudes of the larger non-disabled society, too.

239 pages. $2.99. Mic 56-1863

A STUDY OF CERTAIN IMPLICATIONS OF A CONCEPTION OF ATTITUDES AS IMPLICIT VERBAL RESPONSES

(Publication No. 16,641)

Wilson Whitaker Kimbrough Jr., Ph.D.
University of Maryland, 1956

Supervisor: Professor Charles N. Cofer

The purpose of the present investigation was to test certain implications of attitudes defined as implicit verbal responses which mediate behavior, which are evocable by patterns of stimuli, and which have drive and cue value. The general hypothesis underlying this study is that as a function of attitude differences, individuals should respond differently to stimuli representing different points on a continuum of similarity to a word representing the attitude.

To test this hypothesis, an attitude scale was developed by means of the Guttman technique. The attitude scale was designed to measure experimental subjects' favorableness of attitude toward the law. Another group of subjects rated a number of words as to their commonness of meaning with the word, "law", and from these words, a pair of words was selected for each of three widely separated points of similarity to the word, "law".

The experimental subjects were then divided into three groups, each group representing the range of attitude scale scores. Each group gave verbal associations for five minutes to a pair of stimulus words representing a point on the continuum of similarity of meaning to the word, "law". The first hypothesis was that number of associations given in 5 minutes should vary as a function of attitude and/or degree of similarity of the stimulus words to the word, "law". The statistical analyses do not confirm any of these expectations.

The second hypothesis was that the content of associations given should vary as a function of attitude or degree of similarity of the stimulus word or both. In order to test this hypothesis, it was necessary to develop a method for scoring the content of associations. The method may be summarized as follows. A group of 148 subjects who had not participated in the previous tests was presented with the word, "law", and was asked to give associations for 5 minutes. Each word-association given by a subject was then given a score (5 if it occurred in the first minute, 4 if in the second minute, and so on), and then these scores were summed for the group as a whole for each associate. Thus, for each associate there was for this new normative group which had associated to the attitude concept, "law", an "associative value" score.

The next step was to evaluate each associate given by the three experimental groups of subjects who had associated to the pairs of scaled stimulus words in terms of the associative value scores obtained from the normative group. The results of the statistical analysis of the associative value scores for experimental subjects confirmed the expectation that content of verbal associations is a function of degree of commonness of meaning among stimulus words.

A partial correlation coefficient was computed for each experimental group (subjects associating to a pair of words) to determine the extent of relationship between favorableness of attitude and content of association with the influence of verbal fluency held constant. Insignificant

coefficients were found for the groups which had associated to the highly similar pair of words and to the least similar pair. However, a significant negative coefficient was obtained for the groups which had associated to the pair judged as intermediate in similarity to law. The negative coefficient may be interpreted as indicating that increases in favorableness of attitude toward law are associated with increases in associative value of word associations to words of intermediate similarity.

The results of the study suggest that the method which was used to score word-associations for content should be useful in analyzing association data for content. The results also provide some evidence for the interpretation of attitudes as implicit verbal responses.

147 pages. $1.84. Mic 56-1864

SOCIOLOGY

SOCIOLOGY, GENERAL

SOME FACTORS IN INTERGENERATIONAL OCCUPATIONAL MOBILITY

(Publication No. 16,322)

William Dorfman, Ph.D.
University of Pennsylvania, 1956

Supervisor: E. P. Hutchinson

This is an empirical study of intergenerational vertical occupational mobility as measured by change in occupational level from father to son. Various hypotheses are tested on the relations between occupational mobility and background variables in the areas of marriage, education, occupational career, religion, etc., as well as attitudinal variables in the areas of success conception and occupational aspiration.

The data are obtained from two lengthy questionnaires, administered in 1952 to a 10% random sample of Norristown, Penna., households. This household survey was conducted as part of an investigation of technological change and social adjustment, financed by the Ford Foundation. From these households 623 white men over 25 years of age were found, for whom occupation of father was known. Finally, the 544 men whose fathers were not farmers were selected to be a sample for most of this dissertation's statistical analysis.

A slight modification of the 1950 U. S. Census classification of occupations is used to form a six level hierarchical scale of occupational status. Subjects are categorized as upwardly mobile, immobile and downwardly mobile on the basis of father's usual occupation and own present occupation. In measuring extent of mobility, the effect of change in occupational distribution from father's generation to son's is eliminated by using ratios of observed frequency to those expected if the two occupational levels are independent. This technique has been employed under different names by Natalie Rogoff, David Glass, Marcel Bresard and Livio Livi. Chi-square and Student's t are used to test the statistical significance of differential responses to items of the questionnaires according to mobility categories. In testing associations for significance, occupational level of father is held constant by using a Likelihood Ratio Test for Partial Contingency.

A partial listing of findings follows:

1. Intergenerational occupational mobility in Norristown is similar in extent and direction to that found in other studies, here and abroad. There is more upward mobility than downward, more upward mobility from middle level origins than from low levels, and the highest rates of inheritance are found for sons of proprietors and craftsmen.

2. More upward mobility from father to son than from paternal grandfather to father indicates increased opportunity with time.

3. Upward occupational mobility is positively associated with high status characteristics of wife, that is to say high occupational level of father-in-law, high educational level of wife and third generation nativity of wife.

4. Upward mobility is associated with greater age at first child and greater time interval between marriage and first child.

5. Subject's educational level predicts subject's occupational level as well as does father's occupational level.

6. Subject's occupational level tends to be low where father, father-in-law, paternal grandfather or maternal grandfather is farmer.

7. Upward mobility is associated with white collar first job, advancement to higher occupational level from time of first job to time of marriage, and advancement from time of marriage to present.

8. Upward mobility is associated with definition of success in terms of work and prestige, and downward mobility is associated with definition in terms of security.

9. Significant relations with occupational mobility are also found for sibling's occupational mobility, social class self-placement, religion, ethnicity and socialization with friends or relatives.

10. In many areas, a relative uniformity of belief and behavior for mobile and immobile alike is encountered; e.g. age at marriage, number of children, migration, voting behavior, perceived factors in success, perceived change in ease of getting ahead and intermarriage across religious lines.

11. Associations are sometimes weaker for young subjects than for older ones, suggesting a weakening in the influence of certain factors.

12. The frequently greater associations for low level origins indicates the greater change in behavior required for upward mobility from these origins.

This dissertation includes an extensive discussion of the problems of occupational scaling.

372 pages. $4.65. Mic 56-1865

SOCIAL RESPONSE AND CULTURE CHANGE IN LABORATORY SOCIETIES

(Publication No. 13,764)

William Sidney Felton, Jr., Ph.D.
University of Colorado, 1955

Supervisor: Associate Professor Edward L. Rose

This thesis is concerned with an understanding of relationships between social response and culture change in societies created in the laboratory. A series of experiments were conducted that involved the creation of model societies and history that made possible the experimental creation of culture.

Data were obtained by bringing individuals together to form small groups whose members responded individually to the same two Rorschach (inkblot) cards within a series of definite time intervals. In addition, the individuals in each of the groups responded to the ideas suggested by others in their group regarding the Rorschach cards. The spread of ideas was traced within and between these groups whose membership composition was varied according to the specific research design used in each particular experiment. Response to the inkblot cards constituted culture response. Response to the ideas of others constituted social response.

The social environments distinguished in the experiments were closed and open societies. The open society was characterized by changes in group membership, the closed society by stability of group membership during a series of sessions. Sessions were time intervals in the experiments.

Social response for groups was represented by social acceptance and social rejection. Social response for individuals was represented by agreement or disagreement with the ideas of others and by acceptance or rejection by others of one's own ideas. Culture response was expressed through inventions, borrowings, habits and culbits. An invention constituted an original idea. A borrowing constituted an idea borrowed from another individual. A habit constituted repetition of an idea by the individual who invented it. A culbit constituted repetition of an idea borrowed from someone else.

Four critical experiments on social and cultural response in closed and open societies were undertaken. Two experiments involved a contrast between closed and open societies with the closed society preceding the open society. Another experiment involved a comparison between two closed societies. A final experiment compared open and closed societies with the open society preceding the closed society.

Some individual and group data relationships, irrespective of closed and open environments, are indicated as follows. No sustained significant relationship was found between invention and social response for either individuals or groups. Culture borrowings had a significant direct relationship with agreement and acceptance in regard to individuals and no significant relationship with social acceptance in regard to groups. Significant inverse relationships were found between habits and agreement among individuals and between habits and social acceptance among groups. Significant direct relationships were not sustained between culbits and acceptance among both individuals and groups. Agreement and acceptance had a significant direct relationship to each other.

Group data comparisons in closed and open societies indicate the following relationships. Social acceptance increased when persons entered a closed society from an open society and decreased when they entered an open society from a closed society. No significant relationship existed as to the prevalence of social acceptance in a closed or open society when the open society was preceded by a closed society. Social acceptance tended to increase significantly during the open society. No significant increase of social acceptance was apparent during the closed society. Social acceptance was significantly higher in a closed society than in an open society when the closed society was preceded by an open society.

Highest predictive significance for social and culture response relationships was found for the direct relationship between borrowings and both agreement and acceptance among individuals and for the inverse relationship between habits and social acceptance among groups both with and without regard to closed and open environments. The relationships between both invention and culbits to social response are uncertain and unsustained.

216 pages. $2.70. Mic 56-1866

THE CHURCH SELF-SURVEY: A METHODOLOGICAL INQUIRY

(Publication No. 16,738)

James Harold Fox, Ph.D.
The American University, 1956

Under the impact of industrialization, urbanization, and the Protestant Reformation, the religious institution of the Western World has been experiencing changes in its structure. These changes have, in turn, affected the adjustment of the religious institution to an urban environment.

A considerable amount of religious research has been conducted in the United States in order to gain some insight into the nature of the changes in structure which have occurred, and to provide a basis for a more efficient operation of the churches. The questions which many of these studies attempted to answer pertain to the efficient operation of the religious institution.

A study of the Episcopal Diocese of Washington, which had essentially the same objective, was conducted. The purposes of this study were: (1) To identify the areas of the Diocese not now being reached by the parishes, so as to consider ways of meeting these needs; and (2) To encourage the clergy and lay leadership to examine their own effectiveness in the area they are serving.

The methodology varied from many church studies. For instance, it was built upon original data rather than relying solely upon those available in published journals. In addition, extensive use was made of volunteer laymen in collecting the data. Finally, the techniques provided for the location of church members by census tracts rather than the 1-2-3 mile radii approach.

Since the data were tabulated by census tracts, it was possible to determine the similarities and differences

between the total population and the Episcopal population for any census tract or group of tracts. These comparisons indicated the characteristics of those individuals who are being attracted to the Episcopal Church, and conversely, the characteristics of those who are not. In addition, knowing the demographic characteristics of Episcopalians, one can determine the areas where potential Episcopalians reside. This provided a key to the problem of where to start "new work."

An attempt was also made to utilize the data gathered through the survey process to construct an index of effectiveness. The elements which comprised the index related to the acts of individuals rather than to the activities of the churches. The elements included were: attendance, pledging, "drop-outs," (those persons no longer active in the Episcopal Church), and increase or decrease in the membership of the churches. These elements were weighted by subjective evaluation of the congregations by a competent judge.

The elements in the index relate to overt behavioral patterns of individuals. It is assumed that individuals who attend church services, pledge, and maintain their association with the Church are more effectively related to their congregations than are individuals who do none of these things; and, after correcting for environmental factors, congregations which have proportionately more individuals so related are more effective than those congregations with proportionately fewer such people.

The adequacy of the index was subject to question, however, since the simple correlation coefficient between the index and the subjective evaluation was +.39. Upon analysis it was determined that the evaluation gave greater weight to items of efficiency than did the index.

An operational distinction between efficiency and effectiveness was made. Efficiency pertains to the structure and organization of a church, the ways and means it utilizes in order to perform its functions. Effectiveness pertains to the functioning of the church, the extent to which individuals participate in its life. The distinction is important because it relates to an implicit assumption in much religious research—the assumption that an efficient church is necessarily an effective one. This assumption is open to question on the basis of the material in this study. 203 pages. $2.54. Mic 56-1867

AN INVESTIGATION OF RURAL-URBAN AND OTHER FERTILITY DIFFERENTIALS IN THE STATE OF WASHINGTON: 1860-1950

(Publication No. 16,533)

Don Cary Gibbons, Ph.D.
University of Washington, 1956

This study is an investigation of fertility in the state of Washington. The research concerned a group of fertility differentials which have been reported in demographic literature. These can be briefly summarized. First, fertility has been shown as varying with rural and urban characteristics, i.e., the more rural the population, the higher the fertility. Secondly, fertility tends to increase in a gradient fashion with distance from large, metropolitan centers. In addition, fertility tends to vary inversely with city size. Finally, fertility tends to vary inversely with socioeconomic status in both urban and rural areas.

The data for this research were obtained from two primary sources, United States Bureau of the Census publications and special tabulations of vital statistics. The census data were used both for fertility rates and for measures of rural-urban and economic status. Several indexes of rural-urban character were also constructed from these materials. The vital statistics data were used to construct standardized fertility rates.

The major findings of this study are the following:

a. Examination of general trends in fertility shows that fertility has been declining in this state in the historical period from 1860 to 1940, with some recovery in the decade between 1940 and 1950. The range of variation in fertility among counties has decreased.

b. Examination of fertility ratios for counties in the state suggests that a fairly strong rural-urban fertility variation has existed for many years and is of considerable importance at present. The possibility that this rural-urban variation is the result of differences in age structure for females in the childbearing ages between counties and not in fertility, per se, was studied. Certain procedures used to standardize fertility ratios for age variations among counties produced results which indicate that the rural-urban fertility variation was even more important than originally indicated. Urban, low fertility counties in the state have an age structure favorable to showing their fertility in its best light, while rural counties have an age structure which produces an understatement of their fertility.

c. No significant gradient tendencies were discovered, nor was there a strong relationship between fertility and city size found for this state.

d. No striking socioeconomic variations in fertility were found, either in large cities or rural-farm areas.

Attention was given to the factors which might explain this rural-urban differential in fertility. Information was examined relative to the effects of marriage variations between counties upon fertility. These data suggest that differences in the proportions of persons married in rural and urban areas account, in part, for this fertility variation. The effects of migration upon fertility and the role of attitudinal differences were examined. This part of the analysis did not produce definitive conclusions, owing to the inadequacies of the available data. Further attention must be given to these questions before the rural-urban fertility variation can be fully explained.

151 pages. $1.89. Mic 56-1868

SOCIOLOGY, RACE QUESTION

A SOCIAL PSYCHOLOGICAL STUDY OF MOTION PICTURE AUDIENCE BEHAVIOR: A CASE STUDY OF THE NEGRO IMAGE IN MASS COMMUNICATION

(Publication No. 16,145)

Samuel William Bloom, Ph.D.
The University of Wisconsin, 1956

Supervisor: Associate Professor Hans H. Gerth

There are two major problem areas equally involved in this study: (1) mass media effects, as defined by mass communications research, and (2) social perception, as investigated in the early work of T.M. Newcomb and the more recent studies of R.K. Merton and S. Asch.

More precisely, this is a case study of Lost Boundaries, one of an unusual cycle of recent films depicting the role of the Negro in American life. Lost Boundaries was studied intensively in terms of its place in the history of films, its content, and its measured effects on the members of a small college community.

Reactions to the film were measured by a questionnaire given to each respondent immediately after he had seen the film. Such response was analyzed as a dependent variable which, hypothetically, is related to prior individual attitude (independent variable) and social climate (independent variable). Methodologically, the Newcomb Bennington Study served as the model for the measurement of social climate; individual attitudes, according to "ethnocentrism" and "authoritarianism", were measured by scales essentially the same as those of T.W. Adorno and his associates.

Historically, the Hollywood image of the Negro followed a changing pattern suggestively similar to that of general public mores concerning Negro minorities in America. The trend of this image is clear,—away from Jim Crow and toward an equalitarian ethic. The film-makers, however, appear to be the followers in this evolutionary process and not opinion leaders. The latter conclusion is supported by the content analysis of Lost Boundaries which shows that, even now when the public has signified a readiness for commercial "entertainment" films which deal with significant social problems, Hollywood remains cautious. This film, on the surface a forthright and sympathetic portrayal of a racial dilemma, is actually a miracle of fence-straddling. The content analysis suggests that Lost Boundaries possesses a "projective ambiguity" which allows the individual member of its audience to find in it what he, from his own particular frame of reference, wants to find, and to emerge feeling that what he perceives is what the film was intended to mean. It was predicted that "the most bigoted Negrophobe can be expected to admire the main character and the picture as a whole, so that it is not likely that general responses to the film will differ greatly even when comparing the bigot with the Negrophile." For the respondents of this investigation, this prediction proved to be accurate. On the other hand, responses to the details of the film's themes, incidents, and characters were found to differ significantly according to determinants of attitude and social climate.

The main conclusions of the investigation may be summarized as follows:

(1) Social climate, as defined by Newcomb, significantly affects the way individuals report their reactions to mass communication. In this case, when Lost Boundaries raised controversial issues which the membership group (a liberal college community or a conservative high school community) clearly approved or disapproved, individual respondents tended to yield in subjective orientations (attitudes) which might contradict the group norms.

(2) Subjective orientation (attitude) is a significant determinant of response, and probably the primary determinant of perception. The evidence for this is found in those instances when individual respondents were unable to clearly anticipate the opinion which prevailed among their peer associates in the community,—when, in other words, the opinion climate was cloudy and the direction of group sanction was uncertain. Under these circumstances, respondents tended to fall back on subjective orientation as the source of their reported reactions. This finding encourages the conclusion that the vortex of independent and yielding behavior is in the individual personality. When a subject yields to group pressures, it appears that he changes his manifest judgment and sometimes the report of what he perceives, but that the basic perception involved is not changed. 439 pages. $5.49. Mic 56-1869

COURT TREATMENT OF INTRA AND INTER-RACIAL HOMICIDE IN SAINT LOUIS

(Publication No. 16,629)

Lionel Hodge Newsom, Ph.D.
Washington University, 1956

Chairman: Dr. Stuart A. Queen

The Problem:

This study was undertaken in an attempt to test two major hypotheses and several sub-hypotheses. The first major hypothesis was that there is differential treatment by the courts in intra and inter-racial homicides. The four leading sub-hypotheses related to the first major hypothesis were stated in the order of expectations of severity of punishment, from the most severe to the most lenient as follows: (1) Negro-White; (2) White-White; (3) Negro-Negro; and (4) White-Negro. Our second major hypothesis was based upon the assumption, that if differential treatment exists, it is in harmony with popular attitudes, expressions, and opinions of court officials and what the defendant expects.

Scope:

This study is based on every intra and inter-racial homicide, for which an alleged offender was apprehended, occurring in the City of St. Louis during the five year period, January 1, 1943 to December 31, 1947. A total of 331 offenders and their victims were studied, including 248 Negro and 83 white offenders. Also included in the study are interviews with 18 circuit judges, 3 assistant circuit attorneys, 1 parole officer, 1 public defender, and 15 Negro inmates at the Missouri State Penitentiary.

Other data pertaining to the second major hypothesis were collected from novels, periodicals, and newspapers, dealing with and reflecting various opinions and attitudes toward homicides and punishment.

Methodology:

The data for the study are from records of the Coroner's, Grand Jury's, Circuit Attorney's, and the Criminal Clerk's office. The desired data were transferred to schedules prepared on the victim and the defendant. Responses were coded and data transferred to IBM cards for purposes of more rapid and cross tabulations. A list of desired tables was prepared and the absolute numbers, percentages and other ratios were compared for the four types of offender-victim categories. We compared relative proportions and ratios of each category receiving the minimizing and/or maximizing effects of the action taken at each level of handling. As regards the several phases of the judicial procedure, leniency and severity were defined empirically and suitable criteria and instruments were designed for purposes of determining differential treatment of the four type-situations. The final analysis of the absolute numbers, ratios and percentages was based on the method of chi-square at the 5 per cent level.

Findings:

On the bases of the 331 cases studied we find that there is an association between the race of the offender and the race of the victim. Homicide in St. Louis is essentially an in-group phenomenon. Further examination showed that Negro intra-racial offenders are held more frequently and for the more serious degrees of homicide than white intra-racial offenders, by all four echelons of court action. With reference to sex differentials we found that males commit homicides far more frequently than females, but that Negro females far exceed white females. With reference to type and length of sentence we found that Negro intra-racial and white intra-racial offenders are treated approximately the same but that Negro inter-racial offenders are treated most severely of the four categories studied, while white inter-racial offenders suffered no punishment. More specifically, all Negro inter-racial offenders were convicted and received longer average sentences than any other category.

Conclusion:

On the basis of this study the general conclusion is that there is differential treatment by the courts in intra and inter-racial homicides in the City of St. Louis, in spite of the apparent equality of treatment of intra-racial offenders. The differential is obscured by the significantly large proportion of Negro intra-racial offenders permitted to plead guilty to lesser charges. Negro-white slayers and white-Negro slayers are treated as expected. Furthermore, the literature, news releases, and interviews reflected attitudes, expressions, and opinions in general harmony with existing differential treatment.

131 pages. $1.64. Mic 56-1870

SPEECH, THEATER

ITALIAN STAGE MACHINERY, 1500-1700

(Publication No. 16,408)

Orville Kurth Larson, Ph.D.
University of Illinois, 1956

Although the stage machines which were perfected in Italy during the seventeenth century dominated technical practices throughout Europe for nearly two hundred years, no systematic investigation has been made of them by theatre historians, not even by those particularly concerned with stage machinery. This study aims to remedy that omission.

It surveys and evaluates the development of stage machinery in the Italian theatre from 1500 to 1700, beginning with its origins in the thirteenth, fourteenth, and fifteenth centuries, following its growth through the sixteenth century, and concluding with its culmination in the seventeenth century. Descriptive accounts, technical instructions, stage designs, and technical drawings form the basis for this investigation. Special attention is given to the little-known accounts by the Bishop of Souzdal of Florentine sacre rappresentazioni in 1439 which I have translated from the Italian; Vasari's detailed descriptions of machines for the sacre rappresentazioni; Bernardo Buontalenti's machinery for the Florentine intermezzi of 1585 and 1589; Nicola Sabbattini's instructions for machinery in his Pratica di fabricar scene e machine which I have translated and summarized; Giacomo Torelli's production of Il Bellerofonte; and the extant folios of technical drawings of seventeenth-century stage machinery, namely, the folio in the Biblioteca Palatina in Parma, Italy and the San Salvatore di Venezia folio in Paris. Eighty-nine plates of stage designs and drawings, including technical drawings from the above folios, are reproduced and analyzed.

Many of the machines originated in the mediaeval religious drama and became highly developed during the fifteenth century. The most important of these were the flight machines and cloud machines which reached a high peak of development in the Florentine sacre rappresentazioni. The effects these machines created became traditional and constituted the core of the concept of stage spectacle which was developed and refined in Italy during the sixteenth and seventeenth centuries.

The intermezzi, which became the most popular theatrical form during the sixteenth century, depended principally upon theatrical effects and many of these effects were achieved by refinements of the machines of the religious drama, which the intermezzi had absorbed. The principal new machines developed in the intermezzi were those for the seascapes, apotheosis scenes, and transformations. The appearance of perspective stimulated an

increase in the number of settings and startling transformations in the intermezzi, which necessitated the development of machinery for shifting scenery. Although periaktoi were first used to shift scenery, knowledge of another classical machine, the scenea ductilis, led to the evolution of the rear shutter, wing, and chariot system, which was to prevail not only in Italy but all over Europe.

One objective of this investigation was to clarify the confusion surrounding the development of the chariot system of moveable wings generally believed to have been invented by Giacomo Torelli about 1641. There is specific evidence that Gian Battista Aleotti installed a system using a revolving drum and sliding wing in Parma in 1618. The descriptions of Torelli's system seem to indicate that his chief contribution was a counterweight to make the chariots operate more smoothly and rapidly.

The appearance of opera during the seventeenth century gave new impetus to the use of spectacular effects. No machines were invented for opera, but the new form quickly assimilated to its own needs all the effects used in the intermezzi, and in the process elaborated and standardized the traditional machinery necessary to create them.

By the end of the seventeenth century, the Italian theatre possessed all the stage machinery which was to spread throughout Europe, and this machinery was highly perfected and thoroughly standardized. It included machines for the creation of effects such as the phenomena of nature—lightning and thunder, sunrises, rainbows, and stars—; wave machines for seascapes; sea-monsters and sea-cars; cloud machines that conveyed individuals as well as those that carried groups of personages, individual flights; flying chariots and flying animals; traps of all kinds; machines for apotheosis scenes; and most important of all, the shutter and chariot system for shifting scenery and effecting transformations.

311 pages. $3.89. Mic 56-1871

ZOOLOGY

STUDIES ON ISOLATED NUCLEI FROM THE OOCYTES OF TRITURUS VIRIDESCENS. THE EFFECTS OF IONS AND TONICITY UPON THE VOLUME OF THE NUCLEUS.

(Publication No. 16,548)

William Thomas Battin, Ph.D.
University of Minnesota, 1956

The behavior of nuclei isolated from oocytes of Triturus viridescens was examined to define more clearly the effects of isolation upon the cell nucleus. The germinal vesicle was chosen because it can be isolated by hand dissection and observed from the moment of cell rupture. The germinal vesicle swells upon isolation from the oocyte. This swelling occurs even in solutions which are hypertonic to the whole oocyte. The relationship between the volume of the nucleus and the concentration of the isolation medium does not fit the Boyle-van't Hoff relationship. The shape of the curve plus the fact that swelling occurs in all salt solutions suggested the hypothesis that the swelling of the nucleus upon isolation is due to the colloidal osmotic pressure of its contents. The hypothesis is supported by the fact that the addition to the medium of 3-4% beef serum albumin will prevent the swelling of the nucleus.

The maintenance of the nucleoplasmic morphology is dependent both upon the salt solution and the pH of that solution. The morphology of the nucleus is best maintained in a solution of 0.14M KH_2PO_4-K_2HPO_4 with a pH of 6.8. This solution will maintain the disposition of the nucleoli and chromosomes for periods up to an hour. Thus to preserve the morphology and the volume of the nucleus a colloidal-salt solution is necessary as an isolation medium. Potassium chloride will preserve the nuclear morphology almost as well as potassium phosphate buffer.

In pure sucrose solutions the nucleus swells to the rupture point, indicating that the nucleus is permeable to sucrose. In addition, this behavior points out the questionable value of using pure sucrose solutions to isolate nuclei. The presence of salt in the isolation medium reduces the rate of sucrose penetration.

The effects of various anions and cations upon the morphology and volume of the isolated nucleus were examined. The anions, thiocynate, iodide, chloride, and acetate, were found to have little effect upon the nuclear volume. Likewise, there was little difference between the cations, lithium, sodium and potassium, in their effect upon nuclear volume. However, among the cations, only potassium maintained the morphology of the nucleus. In both lithium and sodium salts the morphology of the nucleus was quickly disrupted; that is, the nucleoli disappeared and the nucleus became a hollow sphere. Chloride and phosphate were the most effective of the anions in maintaining nuclear integrity.

The properties of the nuclear membrane are affected by the medium used to isolate the nucleus. At pH's around neutrality the membrane can be stretched considerably before it will break apart. At pH's below 5, the membrane tears apart like wet blotting paper rather than pulling out before ripping. As mentioned above, the presence or absence of salt affects the permeability of the membrane to sucrose. The loss of nucleoplasm from nuclei in salt solutions indicates that the stretched membrane is permeable to proteins. This observation may account for the results of N. G. Anderson on rat liver nuclei. He has found that rat liver nuclei isolated by differential centrifugation in a phosphate buffer-sucrose medium are permeable to proteins. The results with Triturus germinal vesicles suggest that the rat liver nuclei would be swollen and thus permeable to proteins.

This study has suggested that the best approximation to a nuclear medium is a 3-4% solution of beef serum albumin in a O.14M KH_2PO_4-K_2HPO_4 buffer with a pH of 6.8. This solution will preserve the original morphology and volume of the germinal vesicle for periods of one half to one hour at 70-80 degrees F. 72 pages. $1.00. Mic 56-1872

THE ECOLOGY OF WATERFOWL POPULATIONS ON STOCK PONDS IN WESTERN SOUTH DAKOTA

(Publication No. 16,550)

Ingalf Gilbert Bue, Ph.D.
University of Minnesota, 1956

Adviser: William H. Marshall

A two-year study in 1950 and 1951 disclosed that stock ponds were instrumental in the establishment of a new waterfowl breeding area in western South Dakota which produced about 200,000 waterfowl per year during the period of study. The Range Program initiated by the United States Department of Agriculture in 1937 was largely responsible for the construction of more than 20,000 of these stock ponds on 16,000 square miles of the Pierre Soil Type in this region.

Of major importance to this study were the breeding species of ducks, namely: Blue-winged teal (Anas discors), Mallard (Anas platyrynchos), Pintail (Anas acuta), Shoveller (Spatula clypeata), Gadwall (Anas strepera), and Baldpate (Anas americana). Over 80 per cent of the breeding population was made up of Blue-winged teal, Mallard and Pintail. The stock ponds were used regularly by diving species of ducks during migration periods but none remained to breed.

Nesting studies disclosed that 55 per cent of the nests were successful while studies based on brood observations showed 65 per cent of the pairs were successful in bringing off broods.

Studies of land-use showed that 88 per cent of the land surface is used for pasture and that grazing practices played an important role in usage of ponds by waterfowl. Overgrazing destroyed shoreline vegetation decreasing the breeding pair population on the ponds and changed the species composition, height, and density of upland grass species to the extent of excluding nesting activities.

The combination of high turbidity which decreased light penetration and over populations of fish reduced plant and animal organisms to the extent that waterfowl usage of the ponds decreased and excluded some species.

A food habits study was made and the relationship of food used to that available is discussed.

Management practices recommended for the highest utilization of the ponds by water fowl were: (1) keeping grazing intensity within the carrying capacity of the range, (2) selective fencing on ponds that are and will continue to be overgrazed, and (3) control of fish populations.

163 pages. $2.04. Mic 56-1873

A COMPARISON OF ANTIMITOTIC AND ANTICOAGULANT ACTIVITY

(Publication No. 16,332)

Alvin Maurice Kaye, Ph.D.
University of Pennsylvania, 1956

Supervisor: Professor L. V. Heilbrunn

A comparison of the antimitotic and anticoagulant activities of Na-heparin, colchicine, p-chloromercuri-benzoate, cow ovary extracts and Spisula egg extracts was made. Antimitotic activity was tested on the eggs of Rana pipiens, Chaetopterus pergamentaceous and Arbacia punctulata. Anticoagulant activity was tested on prothrombin-poor citrated beef plasma, citrated sheep plasma and purified fibrinogen.

Heparin added to eggs within a few minutes after sperm addition inhibited cleavage in frog eggs at 13° C. at a concentration of 1.1×10^{-4} M and in Chaetopterus and Arbacia eggs at 21° C. at the lowest concentration tested, 1.4×10^{-3} M.

Colchicine, added in the same manner, inhibited cleavage of both marine eggs on which it was tested in concentrations in the range of 5×10^{-5} M. Concentrations of 5×10^{-3} M to 5×10^{-6} M failed to affect plasma gelation.

P-chloromercuribenzoate inhibited Arbacia egg cleavage completely at a concentration of 10^{-4} M. At 10^{-5} M it had no effect on cleavage, but partially reversed the antimitotic activity of a cow ovary extract on Arbacia eggs.

Cow ovary extracts inhibited cleavage in Rana, Chaetopterus and Arbacia eggs and showed anticoagulant activity when tested on prothrombin-poor citrated beef plasma activated by thrombin. Cow ovary extract showed no anticoagulant activity in a purified fibrinogen system.

Spisula egg extracts inhibited cleavage in both marine eggs and showed anticoagulant activity in plasma. Both cow ovary and Spisula egg aqueous extracts were resistant to heating and treatment with proteolytic enzymes or lipid solvents, and showed metachromasy with toluidine blue.

Chaetopterus eggs were more susceptible to all agents tested than were Arbacia eggs. Comparisons of antimitotic and anticoagulant activity of different extracts and pure substances were tabulated and their antimitotic and anticoagulant properties were discussed, especially in relation to the heparin lipo-protein complex active in blood.

It was postulated that the effectiveness of mucopolysaccharide antimitotic agents depends on their association with lipo-protein compounds. They exert their effects by inactivating proteolytic enzymes in the protoplasm which normally act on a structural protein to produce the spindle.

81 pages. $1.01. Mic 56-1874

The items following each abstract are: the number of manuscript pages in the dissertation, its cost on microfilm, and the Library of Congress card number. Enlargements 5-1/2 x 8-1/2 inches, 10 cents per page. No postage is charged if check or money order accompanies order.

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